U.S. Army Corps
of Engineers
Huntsville Division

CHEMICAL STOCKPILE DISPOSAL PROGRAM

CENTRAL TRAINING FACILITY (CTF) FACILITY DESIGN ANALYSIS

PREPARED FOR

PROGRAM EXECUTIVE OFFICER-PROGRAM MANAGER
FOR CHEMICAL DEMILITARIZATION

UNDER

CONTRACT NO. DACA87-86-C0084

WITH

U.S. ARMY ENGINEER DIVISION, HUNTSVILLE

PARSONS

September 1988

CTF FACILITY DESIGN ANALYSIS

CONTENTS

CONTENTS (Contd)

SECTION 2 DESIGN REQUIREMENTS AND PROVISIONS (Contd)

SECTION 1

GENERAL DESCRIPTION

1.1 PURPOSE

The purpose of this design analysis is to provide a summary of design provisions and calculations applicable to the project as fullfillment of the contractual requirements for the final design for facilities for the Central Training Facility (CTF) at the Aberdeen Proving Ground (APG).[1]

1.2 AUTHORIZATION

1.2.1 DIRECTIVES

The CTF final design is based on the project development brochure (PDB) for CTF Task E-9: APG facilities, final report, September 1987. The PDB incorporates comments from the office of the Program Executive Officer-Program Manager for Chemical Demilitarization (PEO-PM Cml Demil) and Huntsville Division, Corps of Engineers (CEHND), received at the review meeting on December 8, 1987, and modification P20001 to contract DACA 87-86-c-0084, Appendix A, Title 1. These modifications are included in the original contract DAC A87-86-C-0084, awarded to The Ralph M. Parsons Company on July 21, 1986.

1.2.2 SCOPE

The detailed scope of work is as described in the documents listed in subsection 1.2.1, directives. In general, however, the work includes a final facility design.

1.3 CRITERIA

Facilities criteria are provided in CTF Task E-g: APG facilities project development brochure, final report, September 1987.

1.4 PROJECT DESCRIPTION

1.4.1 CONSTRUCTION SITE

The construction site is at the Edgewood area, within APG, Maryland. The site is bounded by Douglas Road on the north, Second Street on the east, Parrish Road on the south, and Gannon Road on the west. The site had several structures on it that were removed; however, foundations and abandoned utility lines may remain. Utilities are available in close proximity to the site. The site slopes gently to the south and is approximately 10 ft above sea level.

---

[1]Appendix A lists acronyms and abbreviations used in this report.

1.4.2 FUNCTION

The main function of the CTF is to provide training for plant operations for the eight continental United States (CONUS) facilities being constructed for the Chemical Stockpile Disposal Program (CSDP). The CTF will also serve as a public relations center for the CSDP project and as a troubleshooting center for plant operational problems. In addition, the CTF will be utilized to produce operation manuals for the disposal equipment and facilities. The facility is expected to be in use for 7 years as part of the CSDP.

1.4.3 PERSONNEL AND EQUIPMENT

The buildings are designed to house 500 students and up to 60 staff on two shifts. Equipment housed in the building will consist of actual demilitarization equipment such as the rocket shear machine (RSM), scaled-down equipment such as the liquid (LIC) burner train, and models such as the brine reduction area (BRA) and pollution abatement systems (PASs). All process equipment is described in the Process Design Analysis, and all equipment is listed in the Major Equipment List.

1.4.4 CONSTRUCTIBILITY

The CTF consists of five buildings:

(1) Main building
(2) Administration and lecturers office building
(3) Classroom and lunch vending area building
(4) Library and computer training building
(5) Chemical laboratory

The main building houses the process equipment areas and is designed as a steel-framed building with a concrete floor, a concrete and metal deck mezzanine floor, and insulated metal panel exterior walls and roof. A preengineered building is included as an alternative in the bid package.

The chemical laboratory is currently being designed.

The remaining buildings are truckable wood module construction compatible with the lighter usage in these areas and the short duration of the project.

1.5 ECONOMIC SUMMARY

The cost of construction of the CTF has been closely monitored throughout the design process. Due to the short duration of the CSDP, maintenance costs are not regarded as the deciding factor in building costs. Most of the savings possible in the construction contract will reflect favorably on the overall project costs. To this end the building has been designed to be as inexpensive as possible in construction costs, and this has resulted in the choice of modular wood and preengineered buildings for the CTF.

SECTION 2

DESIGN REQUIREMENTS AND PROVISIONS

The basis for the-final design of the APG CTF facilities is the requirement to house and support the munitions demilitarization training program together with its equipment, other demilitarization process supporting equipment, and utilities, and described in this section.

The facility will also act as an information center to explain and illustrate Chemical Stockpile Disposal Program (CSDP) operations and processes and serve as a public affairs activity center.

Troubleshooting of program equipment problems will be undertaken in the nontoxic environment of this building.

2.1 SITE DEVELOPMENT

2.1.1 GENERAL PARAMETERS

A. Site. The CTF is to be located in the Edgewood Area of APG. The five structures will be constructed in the area bounded by Douglas Road, Cannon Road, Parrish Road, and Second Street. The area is currently unoccupied. Parking for the CTF will be provided in lots located along the perimeter roads.

B. Topography. The CTF site is generally flat, is grass covered, and slopes gradually to the south. The area is divided by drainage ditches that run in a north-south direction and end at culverts that allow runoff to flow off the site.

C. Geotechnical Parameters. The geotechnical investigations provided by CEHND show that the surficial soils are predominantly sandy silts (ML) and sandy silty clays (CL-ML) with a high water content. The boring locations are shown on Drawing CT-16-C-3, and the boring logs are on Drawings CT-16-C-14 through CT-16-C-17.

D. Special Considerations. Pavements are designed for frost conditions in accordance with TM 5-818-2, Pavement and Design for Seasonal Frost Conditions. Water lines are to be installed at least 12 in. below the frost penetration depth of 30 in. The soils at the CTF site are generally weak and will lose strength if remolded. For this reason, the subgrade soils are not to be compacted prior to receiving subbase or base materials. The geotechnical report also recommends that tracked vehicles be used for all earthwork.

E. Climatic Parameters. The prevailing winds at the CTF are from the south-southwest from May through August and from the northwest the rest of the year (see Figure 2.1-l). Rainfall data has been extracted from Technical Paper

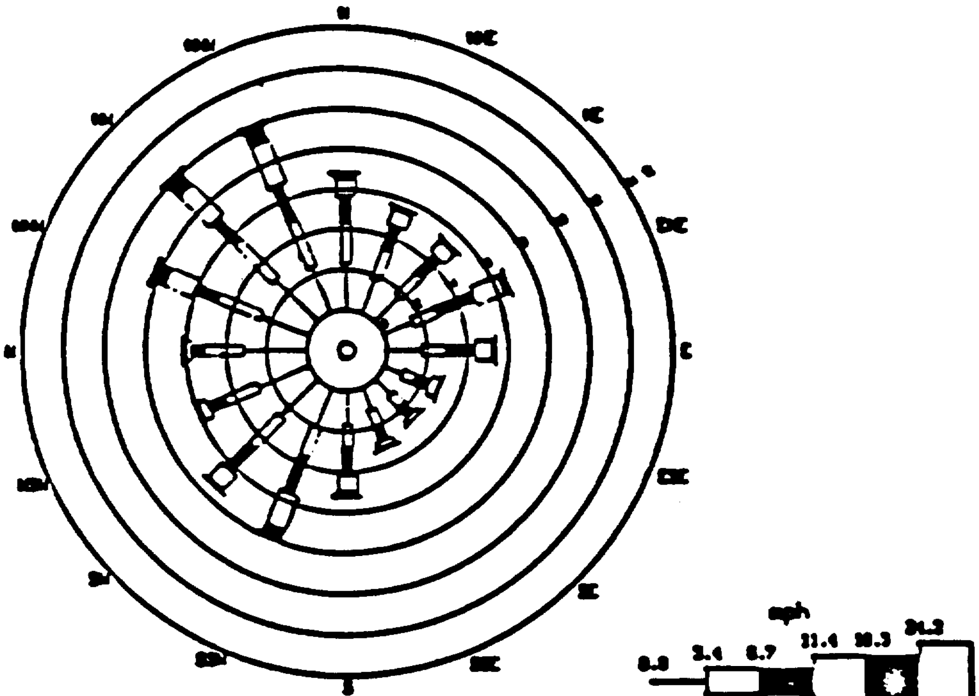

Figure 2.1-l - Average Annual Wind Rose

No. 25, U.S. Weather Bureau (now NOAA) for the Baltimore, Maryland, area and is included with the storm drainage calculations.

F. Installation Compatibility. The CTF is located in the vicinity of the offices of the PEO-PM Cml Demil in a location selected and approved by CEHNP and APG.

G. Disposition of Major Utilities. Of the major utilities, water, sewer, and electricity are available in the immediate vicinity of the CTF site. Natural gas is not available; LPG and fuel oil will be stored onsite. Telephone service needs to be brought approximately 1.5 miles to the facility.

It has been determined that the existing water distribution system is inadequate to meet the needs of the CTF. The determination is based upon flow test data provided to The Ralph M. Parsons Company (Parsons) by CEHND in letter HND-421. The modifications to be undertaken are as follows:

(1) Replace the existing 6-in. and 8-in. lines along Wise Road from the 10-in. tank connection to the 6-h. line along Parrish Road with an 8-in. main.

(2) Replace the 8-in. line along the north side of Douglas Road from Wise Road to Cannon Road. 3

(3) Replace the 6-h. line along the north side of Parrish Road from Wise Road to Cannon Road with an 8-in. main.

(4) Replace the 6-h. lines along Cannon Road and Second Street between Douglas Road and Parrish Road with 8-in. mains.

(5) Replace the existing hydrant at the intersection of Parrish Road and Second Street. wmj

(6) Add four new hydrants around the site perimeter.

. The capacity of the sewage system is adequate based on the time-meter readings for the pump in lift station E4383.

H. Demolition. Demolition of underground utilities as well as any remaining foundations will be the responsibility of the contractor.

I. Proposed Facilities. The proposed building arrangement for the CTF is shown on CT-16-c-2, Overall Site Plan and Vicinity Map. The facilities will include one steel-framed structure and four modular wooden structures.

1. Site Layout. The Maryland State Plane coordinate system is used as the basis for all horizontal control. Vertical control is based on the National Geodetic Vertical datum of 1929. Topography and existing facilities shown on the drawings are based on information contained in topographic survey drawings provided by CEHND and produced by STV/Lyon Associates, October 1987 (Drawing 61-7813-25 sheets 1 and 2). The centerline of Douglas Road was established as the baseline for the CTF site. The baseline has a bearing of N 77°47'58" E,

and a station of 100+00.00 was established by **Parsons** for the intersection of Douglas Road and Gannon Road.

Coordinate point numbers used in the calculations and on the drawings are divided into 10 series, each for a different utility or classification of work.

2. Roads. Roadways at the CTF site are designed for use by vehicles with American Association of State Highway and Transportation Officials (AASHTO) designations of P, SU, BUS, WB-40, and WB-50. Areas subject to frequent forklift traffic have pavements designed for these additional requirements. Second Street will be reconstructed 16 ft wide, matching its existing configuration; *however*, Cannon Road will be 20 ft wide to accommodate the higher volume of truck and bus traffic anticipated. A minimum edge of pavement radius **of** 15 ft has been used. These small radius intersections will require all trucks and buses to swing onto the opposite side of the roadway in order to negotiate the turns.

Coordinates have been calculated for all roadway intersections, and curve data has been generated for the edge-of-pavement layout. The 200 series of point numbers has been used for **roadway** layout.

3. Buildings. The structures at the CTF have been sited so that the building separation distances required in the Uniform Building Code have been met.

Buildings, major exterior equipment, and tanks are located by coordinate as well as by station and offset from the baseline. The work points for the main building are the intersections **of** building column lines, while those for the modular structures are at the exterior corners. Equipment and tanks are **generally** located along their centerlines. The "0" series of point numbers is used for building and equipment work points.

4. Utility Systems. The main lines and laterals of the water, sewer, and storm drain systems dimensioned on the plans are parallel or perpendicular to the baseline.

5. Fencing. To discourage vandalism, fencing is provided around exterior tanks and equipment. Fencing consists of **7-ft-high** wire-mesh fabric attached to steel pipe posts set in concrete.

J. Local Construction Practices. Not applicable.

K. Construction Permit Requirements. An excavation permit must be obtained from the APG installation engineer before any excavation or grading can be started.

L. Environmental Protection. The sanitary sewer effluent from the CTF will be treated in a National Pollutant Discharge Elimination System (NPDES) and State of Maryland permitted wastewater treatment plant. No hazardous wastes are being discharged to the sewer system at the CTF. The storm drainage from the site will be discharged to a detention basin and then routed to existing drainage into the Gunpowder River. The State of Maryland requires an Erosion and Sediment Control Plan and a Stormwater Management Plan to be produced.

M. Site Plan. The site plan has been reviewed by APG, and CEHND has directed Parsons to proceed with design based upon the siting shown in Drawing CT-16-C-2 Rev j.

2.1.2 FUNCTIONAL AND TECHNICAL REQUIREMENTS

A. Exterior Functional Areas. Locations of buildings shown on the site plan are in functional relationship to each other for operational efficiency while maintaining the required building code separation distances.

B. Energy Conservation and Site Preparation. The design considers energy conservation in a manner that is consistent with the 7-year life of the facility. Fill has been minimized under the main building due to the nature of the existing soils.

C. Building Setbacks. Building setbacks vary but are generally at least 15 ft from the edge of roadways. In some areas, parking extends into the 15-ft setback. Because explosives and chemical agent will not be used in, the training at CTF, there are no intraline or inhabited building distance requirements.

D. Parking and Access Roads. A total of 17 parking spaces have been provided for buses that will transport students to the CTF. A total of 54 automobile parking spaces are also provided, three of which are for handicapped individuals. These spaces are for the faculty, staff, and visitors. The basis for the number of bus and automobile spaces is the CSDP Training Concept Report and Conceptual Plot Plan developed by Jacobs Engineering. Automobile spaces have been placed along Gannon Road, Parrish Road, and Second Street.

Access to the site will be via existing roads, primarily Hoadley Road to Parrish Road.

Site roads are designed in accordance with the pavement structural design provided by CEHND and the following criteria:

(1) Types of vehicles: AASHTO designations P, SU, BUS, WB-40, WB-50, and forklifts.

(2) Maximum weight of vehicles: HS20.

(3) Personnel occupancy of facility: 545, first shift; and 520, second shift.

(4) Traffic marking: In accordance with TM 5-822-2

(5) Type of pavement: Portland cement concrete is used for the fuel unloading area and at the west end of the main building where supplies will be unloaded. These areas, subject to high wheel loads, are designed in accordance with TM 5-822-6. Asphalt concrete paving for the balance of the roads, parking, and general purpose areas is designed to the requirements of TM 5-822-5.

(6) Grade restrictions: Grades are designed to accommodate the expected types of vehicular traffic and their associated operating characteristics in accordance with TM 5-822-2, Table 2. Since the site is relatively flat, most paving is sloped less than 3%.

(7) Curb and gutter: In keeping with the general design at APG, curbs and gutters have not been provided along the roadways at the CTF. Curbs have been provided around pump areas to contain any potential leakage.

(8) Road Classification: The existing roads around the CTF are classified as Class E - 16 ft wide; however, TM 5-822-2 specifies that the lane width should be a minimum of 10 ft. The 16-ft width has been maintained except for Gannon Road, which was widened to 20 ft because of the bus traffic.

(9) Design Life: As established by the CEHND-provided pavement structural design.

E. Service Areas. Fuel oil, LPG, and glycol will be delivered to the unloading area at the northeast corner of the site. Other deliveries to the main building will be to the northwest corner, off Gannon Road.

F. Heliport. Not applicable.

G. Sidewalks and Fencing. A concrete sidewalk is provided between the main building and the four modular structures. Raised wooden sidewalks are provided along the modular structures and tie in to the central walkway. A 7-ft-high chain-link fence is provided around the yard area, isolating the equipment and tankage from public accessability.

H. Security Requirements. There are no site security requirements since the CTF will be located on a military post with its inherent security system.

I. Exterior Utility Support Systems.

1. Looped Water Distribution Network. The CTF will tie into the existing water distribution network. The mains surrounding the CTF are being replaced to meet the potable, industrial, and fire protection needs.

The CTF is estimated to require a peak flow rate of 2,075 gal/min (2,000 gal/min, fire; 64 gal/min, potable; 11 gal/min, process) under fire conditions with a residual pressure of 20 psi at the hydrants. The portion of the distribution grid in the vicinity of the CTF has been modeled using a Hardy-Cross type of computer program to evaluate flow rates and pressure drops.

2. Sanitary Sewer System. All sewer lines from the CTF will connect to the existing sanitary sewer system. Two new laterals will connect to the existing lateral along Parrish Road with new manholes. The west lateral will serve the laboratory and library/computer buildings, and the east line will serve the main building, classroom module, and administration building. All building connections and laterals are designed in accordance with the requirements of TM 5-814-1, Sanitary and Industrial Wastewater Collection - Gravity Sewers and Appurtenances.

The sanitary sewer system is designed on the following basis:

(1) Minimum pipe size is 6 in. diameter for laterals.

(2) Design velocity is a minimum of 2.0 ft/sec at the average daily flow rate and a minimum velocity of 2.5 to 3.5 ft/sec at the peak diurnal flow rate.

(3) Manholes are located at change of slopes, direction, or every 300 ft, whichever occurs first.

(4) Cleanouts are provided at changes in direction and building connections.

(5) Laterals are designed to flow at depths not exceeding 80% of full depth.

(6) Gravity sewers are generally designed to maintain subcritical flow conditions in the pipe throughout the normal range of design flows.

3. Storm Drainage Runoff. The current pattern of runoff in the vicinity of the CTF is in a southerly direction flowing in culverts under Douglas Road and Parrish Road. Runoff currently flowing between Gannon Road and Second Street is being diverted on the north side of Douglas Road southwesterly to new culverts under Douglas and Cannon Roads, after which it flows southerly in a ditch to new culverts under Parrish Road. Most of the runoff from the area on the north side of the main building is taken as surface flow around the west side of the site to the new culverts at Parrish Road. Drainage from the diked tank areas and pump pads flow through valved drain lines to the storm drain, which collects runoff from the area on the south side of the main building. Calculations were performed in accordance with TM 5-820-4, Drainage for Areas Other Than Airfields.

Calculations were performed in two parts. First surface runoff flow quantities were derived, using the unit hydrograph method to estimate peak runoff for defined areas and appropriate rainfall intensities and runoff coefficients. Time of concentration is based on the empirical formula for combined overland and channel flow and is not less than 10 minutes. Based on the time of concentration and travel time, the peak runoff can be calculated from the tabular hydrographs for the project site.

Runoff curve numbers used are 74 for undeveloped or unpaved areas and 98 for impervious areas; however, a composite runoff curve number is calculated for mixed areas. A storm frequency of 10 years is used to estimate quantities of peak runoff that is to be diverted as surface flow west of the site, and a storm frequency of 25 years is used to estimate quantities of peak runoff for surface flows within the site.

The second part of the calculations consisted of sizing drainage facilities, based on peak runoff flow quantities to divert runoff away from the project site.

Runoff between the main building and the four modular structures is collected by catch basins, which also collect runoff from the main building's southside roof drains. Runoff from the main building's northside roof drains and the paved area is collected by a slotted drain system and taken by storm drain to where the southside drainage is collected. The storm drain discharges between the classroom and administration buildings where it flows overland to the culverts that empty into the storm drain detention pond. The storm drain lines are a minimum of 12 in. in diameter, and the design velocity is not less than 2.5 ft/sec when greater than 1/3 full.

Sumps and valved drain lines are provided in the diked tank area, pump pads, and fuel unloading area. The valves can be opened after storms to drain the areas provided there is no oil present. If the storm water is contaminated or if there has been a leak or spill, the contaminated liquids must be removed by a vacuum truck or some other method deemed appropriate by the installation.

J. <u>Sound Control.</u> Not applicable.

K. <u>Handicapped Accessibility.</u> Three parking spaces for handicapped persons have been provided. Exterior access to all structures is provided by either concrete or wooden walkways with ramps at grade changes.

L. <u>Grading and Landscaping.</u> Grading at the site consists of overland flow toward swales alongside the roads or between the structures. Flow then proceeds to catch basins or culverts and off the site to existing drainage courses. No irrigation is planned for the CTF site. All nonpaved areas will be seeded with a mixture of grasses to provide erosion protection.

M. <u>Signage.</u> Parking spaces will be indicated by painted lines on the pavement.

N. <u>Area Lighting:</u> Area lighting is provided as discussed in subsection ELECTRICAL.

O. <u>Heliport Illumination.</u> Not applicable.

2.1.3 DESIGN OBJECTIVES AND PROVISIONS

A. Functional Relationship. The CTF is located in the vicinity of the PEO-PM Cml Demil offices in the Edgewood Area of the APG, Maryland. The five buildings composing the CTF are congregated in one area in order to minimize the distance that students need to travel between the classroom and the areas where hands-on training is to be undertaken.

B. Circulation Pattern. A majority of the traffic destined for the CTF will enter the Edgewood Area through the main gate on Hoadley Road. Vehicles will proceed in a-southerly direction to Parrish Road, then eastward to the site. Buses will turn north onto Cannon Road and park to unload students. Facility and staff will park in any of the designated parking areas along Second Street, Parrish Road, or Gannon Road. Deliveries will be made either from Second Street or Gannon Road to the main building or fuel storage area. Vehicles can then leave to the north to Douglas Road, turn left, and proceed to Hoadley Road where they would turn right to leave the installation.

C. Utility Support. The design of the CTF utility system assumes that the existing water system will be capable of supplying a sufficient quantity of water for CTF domestic, industrial, and fire protection needs. Flow tests provided by CEHND show that the existing mains surrounding the CTF cannot meet the needs without modifications. The modifications required consist of replacing sections of the main and providing a fire pump skid at the CTF.

The CTF design as presented calls for a connection into the existing sanitary sewer system with two new manholes on the line along Parrish Road. The flow data from sewage lift station E-4383 shows that the existing pump operates on the order of 15% of the time (0.3 hr in 2 hr); therefore, the size of the lift station is adequate.

D. Physical and Fire Security. No special physical security measures are required for the site. A 7-ft-high chain-link fence is provided around the exterior tanks, pumps, and other equipment. Fire protection is provided by the APG fire department, with alarms tied into the central system.

E. Handicap Accessibility. See subsection 2.1.2K.

F. Landscape Preservation. Where feasible, the existing ground cover of grass will be preserved. Areas disturbed by the construction activities will be reseeded with a mixture of grasses for erosion protection. No irrigation system is planned for the CTF.

G. Economy of Construction. The design of the site considers economy of construction and O&M in a manner consistent with the 7-year life of the facility. The roads are designed in accordance with TM 5-822-5.

H. Future Expansion. No provisions have been made for expansion of the CTF.

2.1.4 CALCULATIONS

See Volume II.

2.1.5 COORDINATION WITH INSTALLATION OR OUTSIDE AGENCIES

A. Approved Siting. Siting of the CTF has been approved by CEHND and APG.

B. Utility Service Capacities. The capacity of the central steam facility is not enough to include use by the CTF. Electrical power and telephone services are available.

C. Water Supply and Sanitary Discharge. Water and sanitary sewer systems are available.

D. Demolition Disposal. Demolition of the existing structures on the site is to be performed by the installation.

E. Construction Permits. Construction permits are the responsibility of CEHND.

F. Environmental Protection. The facility is designed to be in compliance with air and water pollution requirements.

G. Security and Firefighting. Security and firefighting for the CTF are provided by the APG installation.

H. Bulk Trash Disposal. Trash disposal is by outside contractor.

I. Signage. Parking spaces will be indicated by painted lines on the pavement.

J. Explosive Handling Safety. No explosives will be used at the CTF.

2.2 ARCHITECTURAL

2.2.1 CTF MAIN BUILDING

A. General Parameters.

1. Purpose, Functions, and Capacities. The main building houses the training facilities and demilitarization machinery for this project. The building is a two-story building of steel and concrete construction. The upper floor is for the mechanical equipment and observation of the demilitarization equipment room (DER) and unpack area (UPA)

2. Visual Appearance. The exterior is of insulated factory-furnished composite metal panels with a storefront glass entry. The interior is designed to normal commercial standards for this type of building and within the size parameters of Architectural and Engineering Instructions Design Criteria.

3. Number of Personnel. The first floor is designed to house 400 staff and students.

The second floor viewing gallery is designed for up to 40 visitors or students for short periods of time.

4. <u>Type of Activities.</u> The activities carried out in the building are as follows:

(1) Entrance and Model Display Area: This area is used for reception of students and visitors and contains a reception desk that will seat the guards and reception personnel. Exits from this area lead to the corridor system, stairway to the second floor, seminar room, and main assembly room. A model of the TEAD munitions demilitarization facility will be housed in this area.

(2) Seminar Room: This room will be used primarily for activities not directly related to student education, i.e., troubleshooting meetings, public relations activities, etc., and will be used on an as-needed basis for teaching.

(3) Main Assembly Room: This room is sized to accommodate up to 299 staff and students for orientation meetings, films, etc. It can also be used for major public relations activities when required. When not required for major assemblies of people, the room can be subdivided with movable partitions into six smaller rooms suitable for seminars or other teaching activities.

(4) Maintenance Training Areas: This area is divided into five maintenance training rooms and a tools and spare parts area, which will also house facility maintenance personnel. The main maintenance training room is sized for 30 students and will be used for general maintenance training. The four smaller training rooms are sized for up to 15 students and are for more specialized training in the fields of hydraulics,' electrical, mechanical, and instrument calibration. The tools and spare parts area is for storage of hand-held tools and spare parts used in training and also contains a workbench area and storage space for spare parts used for maintaining the process equipment in the building.

(5) Toxic Maintenance Area (TMA): The TMA contains a decon vestibule similar in size to that in the actual demilitarization plants and will be used to train maintenance staff dressed is demilitarization protective ensemble (DPE) suits to decontaminate and maintain pieces of demilitarization equipment. The TMA area includes benches and tool racks similar to those used in the plants.

(6) DPE Area: This area houses all activities related to changing from outside clothing into DPE suits and entering through airlocks into the demilitarization equipment area and TMA. Spaces included are:

(a) Toilets and changing rooms

(b) Protective clothing storage area

(c) DPE suit wash and drying area

(d) DPE area used for dressing in DPE suits.

(e) Airlocks used for simulating entry into and exit from contaminated areas

(7) Unpack Area (UPA): This area is used to simulate the area of a demilitarization plant where munitions are unpacked and loaded onto conveyors that convey them through airlocks into the demilitarization equipment room (DER). This area is housed in part of the high bay area of the building and has a bridge crane above to simulate all of the fixed monorails used in the actual plant. This bridge crane also spans above the DER. An area is set aside in the UPA for recharging dummy munitions for reuse. A forklift truck and Walkie Stacker will be housed in this area for training students to move munitions around in their protection casings.

(8) DER: This room houses most of the actual full-scale demilitarization machinery and material handling equipment and will be used to demonstrate to students how the equipment works, to train maintenance personnel wearing DPE suits in the maintenance requirements of the equipment, and for troubleshooting equipment in a nontoxic environment. Movable sections of wall are provided so that mockups of the actual spaces around machines can be made for training proposes, e.g., explosive containment room (ECR) for RSM and projectile/mortar disassembly (PMD). The bridge crane in the UPA continues across the DER to simulate all of the bridge cranes, monorails, and hoists used in a demilitarization plant, and to allow maintenance of all of the machines and removal of all processed dummy munitions. DPE hose lengths allow maintenance trainees to access all of the equipment in the DER while dressed in DPE suits. A stair and platform is included in the DER for DPE training in climbing and descending stairs.

(9) Barrier Train: A reduced-size LIC will be installed in this area and will be used for training furnace operators in flame control and also for training maintenance personnel wearing DPE suits in the requirements of furnace maintenance.

(10) Furnace BRA and PAS Model Room: This roan will contain models of the four furnaces in a plant together with models of the BRA and PAS. These models will be used to explain to students the workings and arrangement of the various systems.

(11) Control Room (CON): The CON is broken up into three areas. The CON contains one of each type of console in the actual demilitarization plant and is arranged in a similar manner to the CON in the actual plant. The trainer is in a separate room with a glazed wall facing the CON so that he can supervise and observe all training. Also within room is the maintenance console on which training of maintenance operations will take place. The third area contains the computer central processes and disc drives together with two programmer consoles.

(12) Mechanical and Electrical Room: The rooms housing the building mechanical and electrical systems are located at the northeast corner of the building with the electrical room, boiler room, chiller room,

and compressor at the ground floor level and the air handling units at the mezzanine level.

(13) Toilet Rooms: Toilet rooms are provided off the building corridor systems adjacent to the main entrance lobby and are divided into two sections, one for people within the interior of the main building and the other accessible from the outside and the entrance lobby. The toilets are sized to serve the maximum occupancy of the building.

(14) Observation Corridor: An observation corridor is provided at the second floor level overlooking the UPA and DER and will be used for student orientation, visitor observation, and public relations activities. The gallery is accessed from the entrance lobby by a stair and has emergency exit stairs at both ends of the building.

Equipment used in the building will be provided as follows:

(1) Process Equipment: Process equipment is as defined in the Process Design Analysis and the Major Equipment List.

(2) Maintenance Area: Machinery and equipment is to be selected and provided by the operating contractor.

(3) Locker Rooms: All lockers and benches are provided as part of the facility.

(4) Maintenance Shops and Tool and Spare Parts: All benches and storage cabinets are provided as part of the facility. All equipment will be supplied by the system contractor.

(5) CON/Simulator Room: The CON/simulator equipment is provided as part of the process equipment package.

(6) Demilitarization Equipment Room: Demilitarization machinery and material handling equipment will be provided as part of the process equipment package.

(7) Furnace Burner Train: This is part of the process package.

(8) Furnace PAS and BRA Models: These items are part of the process package.

(9) General Loose Furniture: All loose furniture is provided by the Government.

(10) Facility Equipment: All mechanical and electrical facility equipment is provided to produce a fully functional facility.

5. <u>Anticipated Life.</u> The facility is anticipated to be in use for up to 7 years.

6. Type and Method of Construction. The building is a steel-framed structure with canposite metal panel roof and exterior walls and is designated as a temporary structure. An option is included to make the building a preengineered structure.

B. Function and Technical Requirements.

1. Functional Areas.

First Floor	Occupancy	Area (ft^2)
Unpack area	15	3,948
Demilitarization equipment room	up to 45	10,222.5
Locker room	up to 20	907
DPE support area (DSA) and airlocks and clothing storage etc.	up to 20	2,461
Toxic maintenance area	up to 10	1,817
Maintenance shops	(4 x 15) + (1 x 30)	3,661
Maintenance stores	Unoccupied	1,015.5
Mechanical electrical rooms	Unoccupied	2,977
Control room/computers	10	2,275.5
Entrance	up to 50	2,457.5
Assembly room	299 (or 6 x 30)	4,278
Seminar	30	602
Toilet rooms		1,396
Furnace models	30	2,765
Burner train	15	1,770
Second Floor	**Occupancy**	**Area**
Observation gallery	40	1,824
Mechanical/HVAC equipment	Unoccupied	3,353
Corridors/stairs		1,212
Gross building area		58,662
Net building area		38,862

2. Equipment, Furniture, and Furnishings.

	Quantity
Entrance/Models	
Models	2
Wastebaskets	2
Chairs	10
Tables	2
Assembly Room	
Retractable projection screens	5
Projection equipment	5
Chairs (with writing tablets)	299

	Quantity	
Assembly Room (Contd)		
Tables	5	
Podium	1	
Wastebaskets	6	
Seminar Room		
Retractable projection screen	1	
Projection equipment	1	
Wastebaskets	2	
Tables	1	
Chairs (with writing tablets)	50	
CON/Simulator Room		
Chairs	9	
Wastebaskets	3	

	Quantity	Funding[1]
Instrument Electrical	30	
Hydraulic Instrument, Electrical, and Mechanical Maintenance Shops		
Stools	15 x 4 = 60	
Wastebaskets	4 x 4 = 16	
Tool boxes on wheels	4 x 15 = 60	
Maintenance Shop		
Stools	30	
Wastebaskets	8	
Tool boxes on wheels	30	
Men Locker Room		
Lockers, metal, 72 in. full size single tier	43	MCA
Benches, metal (linear feet)	30	MCA
Women Locker Room		
Lockers, metal, 72 in. full size single tier	12	
Trash receptacles	1	
Benches (linear feet)	8	

[1]Funding for items left blank in list is to be determined by the Government.

3. Occupational Safety and Health. The building complies with OSHA requirements.

4. Safety Color Coding. Safety color coding (yellow and black diagonal stripes) will be painted on all physical hazards in accordance with OSHA 1910.14A. Physical hazards will be identified during "safety walkthroughs" during the time the facility is being built.

5. Handicapped Accessibility. Handicapped accessibility is required for visitors and teaching staff; students are required to be able-bodied by the needs of the project.

6. Energy Conservation. Insulation values are in compliance with DOD 4270.1-M and building code. R-19 insulation is used for walls and R-30 for the roof. All windows are double glazed, exterior doors are insulated.

7. Sound and Vibration Control. This has been designed for in the toilet room perimeter walls, control room walls, and assembly and seminar room walls.

8. Physical Security. Keying is individual keying for each door, no master keys will be used. Security and fire alarm systems are linked to the system in the base fire station.

9. Signage. The building has an identification sign at the entrance. Each floor has signs indicating the occupancy of that floor. Each area and room has an identification sign. All exits and exit routes have signs to meet the requirements of the building and fire codes.

10. Finish Materials.

Exterior

Walls	Composite building panels
Roof	Composite building panels
Doors	Hollow metal (insulated), painted
Windows	Color-coated aluminum

Interior

Walls	Fainted gypsum board generally. Epoxy-coated cement plaster in TMA and airlocks; exposed construction in process areas and mechanical rooms. Ceramic tile in shower area and toilets.
Ceiling	Acoustical tile or painted gypsum board.
Door	Painted hollow metal, stained wood in assembly room and entrance areas.
Floors	Vinyl tile, welded sheet vinyl, or epoxy floor covering ceramic tile for toilet rooms. Carpet in entrance, assembly room, and seminar rooms.

C. Design Objectives and Provisions.

1. Adaptation of Building. The building is designed for a 'T-year life for this project. All interior walls are nonload bearing and permit future removal without affecting the structural integrity of the building. The building design permits easy adaptation to other uses. Present design permits future addition of a mezzanine in the high bay area within code requirements using the stairs as designed.

The building is laid out parallel to the existing road system with Douglas Road to the north, Fourth Street to the east, Parrish Road to the south, and Second Street to the west. The service side of the building is to the north, and the main entrance and "public" side is to the south. The modular buildings and the chemical laboratory are located between the main building and Parrish Road. Parking is provided on the east and west sides, and this feeds a main east-west circulation path between the main building and the four smaller buildings. A visitor parking area is located off Parrish Road, and a path leads from this adjacent to the classroom building up to the entrance of the main building and the east-west circulation path.

2. Organization. Each section of the building has specific requirements but each area is fairly independent of functions carried out in other areas. All areas are accessed from the central corridor system.

3. Building Layout. The building is laid out around a single circulation corridor that runs down the middle of the buildings, with an exit door at each end. This provides a very simple circulation system and meets all code requirements. The second floor is similar, with an exit door and stairway at each end. There are secondary exits for the mechanical room area, assembly room, demil room, unpack area, and burner train and furnace model areas.

4. Consolidation of Space. All spaces are consolidated as far as possible into zones of sound compatibility. The wall between the toilets rooms and entrance area is 50 dBA sound attenuation, as are the walls between the control room area and the surrounding spaces. The main hazardous boiler room and furnace areas are divided from the other parts of the building by fire resistive construction. No special provisions have been made for storm or fallout protection.

5. Construction Materials. The building is of structural steel with steel frame and bracing, insulated metal panel siding, concrete on metal deck second floor, concrete ground floor, insulated metal panel roof. Materials are representative of the type and as directed by the criteria.

6. Building Expandibility. Interior partitions are not structural; therefore, they can be rearranged, if required. The building could be extended if adequate space on the site is available, however, no specific provisions have been made for expansion.

7. Physical Security. The building is not designed as a secure facility.

8. Barrier Free Design. The facility is designed for the physically handicapped at ground floor level to serve the needs of handicapped visitors or instructors. Students are required to be able-bodied by the needs of the demilitarization project.

9. Energy Conservation. Items included to conserve energy are:

(1) Wall insulation R-19
(2) Roof insulation R-30
(3) Double glazed windows
(4) Insulated hollow metal exterior doors
(5) Draft seals to exterior doors
(6) High-efficiency HVAC Design

(See Mechanical calculations in Volume 3).

D. Coordination with Installation or Outside Agencies.

1. Physical Security Support. The main building fire protection systems are connected by radio to the APG base systems.

2. Blind Vending Operations. Not applicable.

3. Occupational Safety and Health. The building is designed to comply with all OSHA requirements.

4. Government-Furnished Equipment. All hand-held fire extinguishers and loose furnishings will be supplied by the Government.

2.2.2 LIBRARY/COMPUTER TRAINING

A. General Parameters.

1. Purpose, Functions, and Capacities. The building will house the library, reading room, and personal computer training functions for this project. The building is a one-story building of truckable wood module construction. The building is on one floor and is self-contained with its own toilets.

2. Visual Appearance. The exterior is of stained textured plywood exterior siding with color coated sliding aluminum windows and painted insulated hollow metal doors. Design is intended to minimize a "trailer" appearance and give the appearance of a more permanent structure.

Interior: Design to normal commercial office standards and within the size parameters of Architectural and Engineering Instructions Design Criteria.

3. Number of Personnel. The first floor is designed to house 77 personnel.

4. Type of Activities. The building houses library and computer training functions for the CTF facility.

5. Anticipated Life. The facility is designed for a 'I-year life.

6. Type and Method of Construction. The facility is of truckable wood module construction, is temporary, and is relocatable.

B. Functional and Technical Requirements.

1. Functional Areas.

Floor,	Occupancy	Area (ft^2)
Library	61	3,840
Computer training	16	960
Mechanical equipment		480
Gross building area		5,280
Net building area		4,170

2. Equipment, Furniture, and Furnishings. The following furnishings are provided for Government-occupied spaces.

Item	Quantity
Reproduction machine (Xerox or equal)	1
Computers/word processors	9
Desks	2
Chairs	77
Wastebaskets	10
Tables	8
File cabinets	6
Projection equipment	1

3. Occupational Safety and Health. The building is designed to comply with all OSHA requirements.

4. Handicapped Accessibility. Handicapped accessibility is provided for visitors and lecturers. Students are required to be able-bodied by the needs of the project.

5. Energy Conservation. Insulation values are in compliance with DOD 4270. 1-M and local building code.

6. Sound and Vibration Control. Noise control is not required because the standard construction used reduces the expected equipment noise levels to 35db or less in the normally occupied areas.

No problems are anticipated with vibration of mechanical equipment due to the discontinuous modular construction used in this building.

7. Interior Parking. There are no interior parking or service areas.

8. Physical Security. Keying is a master and submaster systems. Fire alarm system is linked to the main system in the main building.

9. Signage. The building is provided with an identification sign at the entrance and has signs indicating the occupancy of the floor. Each office and room has an identification sign.

All exits and exit routes have signs to meet the requirements of the building and fire code.

10. Exterior and Interior Finish Materials. See subparagraph finish materials.

C. Design Objectives and Provisions.

1. Adaptation of the Building. The building is specifically designed for the CTF.

2. Organization. The floor is arranged with one main entrance opening up to a main reading area. The opposite side of the reading room is the book stack and librarian. Computer training is at the end of building adjacent to the main entrance. Mechanical equipment is at the other end. There is an emergency exit through the book stack room.

3. Building Layout. The building is sited so that all traffic arrives at the main entrance. Exterior doors are arranged for access to mechanical and electrical equipment directly from the outside. The emergency exit is located on the opposite corner of the building from the main entrance. The building is surrounded by open areas for evacuation purposes and is fully accessible to emergency vehicles.

4. Consolidation of Spaces. All the noise-producing functions are located together and separated from the quieter library functions.

5. Space Layout Compatible with Modular Support Systems. The building layout is designed to accommodate the structural needs of a truckable wood module building. Module manufacturers confirm than the building layout is compatible with their systems.

6. Construction Materials.

Exterior

Walls	Textured plywood on wood framing.
Roof	Metal roofing and siding, factory-color-finished, over plywood on wood framing.
Windows	Sliding double glazed aluminum with a factory color coat finish.
Doors and frames	Hollow metal insulated, 3 ft by 7 ft (pairs as required).

Interior

Floors	Vinyl composition tile to book stack office entrance and computer training. Welded vinyl for toilet rooms carpet for reading room.
Walls	Vinyl coated gypsum board generally. Fiberglass wall sheathing for toilet areas.
Ceilings	Acoustical panel lay in grid ceiling generally. Gypsum board (WR) painted for toilet rooms.
Windows	Steel frame similar to hollow metal door frames.
Doors and frames	Hollow metal, 3 ft by 7 ft.
HVAC system	The RVAC system will consist of a central packaged unit in the mechanical room with ductwork located in the ceiling space.
Electrical system	A transformer and main switch panel will be located in the electrical room and will be wired from there throughout the building.

Selected materials are typical for this type of construction.

7. Building Expandibility. The building is of truckable wood module construction and can be easily expanded or reduced by the addition or removal of modules. The interior layout in the open areas can be modified, but modifications in other areas could jeopardize the structural integrity of the modules.

8. Physical Security. Not applicable.

9. Barrier-Free Design. The building is designed to be in compliance with Federal Accessibility Standards.

10. Energy Conservation. Items included to conserve energy are:

(1) Wall insulation R-19
(2) Suspended floor insulation R-19
(3) Roof insulation R-30
(4) Double glazed windows
(5) Insulated hollow metal exterior doors
(6) Draft seals to exterior doors
(7) HVAC system with economizer cycle

11. Acoustical Design. No special acoustical design is necessary.

12. Composition of Masses and Spaces. The building is a simple rectangular shape composed of 11 modules of identical size. The building is designed to be as simple as possible and to minimize maintenance costs.

13. Perception of the Building. The building is designed to be as simple and economical as possible to house the people and functions required. The building is designed to support an industrial process, and this is reflected in the utilitarian design approach.

14. Enhancement of Materials. Materials are suitable for the type of construction and reflect the limited life span of the building.

15. Economy of' Building Construction. The building is designed as economically as possible by choice of construction type, choice of materials and finishes.

The building should be easy to maintain as all systems and utilities are easily accessed either from inside or below. All exterior materials are easily maintained and should cause no problems for the limited life envisaged for this building.

A modular wood building can be relocated to a new site for very little cost, In a short-life building such as this, the reuse reflects very favorably on the life-cycle costs.

D. Calculations. Not applicable.

E. Coordination with Installation of Outside Agencies.

1. Physical Security Support. The library fire protection system is connected to the main building system.

2. Blind Vending Operations. Not applicable.

3. Occupational Safety and Health. The building is designed to comply with all OSHA requirements.

4. Government-Furnished Equipment. All hand-held fire extinguishers and loose furnishing are furnished by the government.

5. Signage. The signage is coordinated in style, size, and type with that used for the remainder of the site.

6. Operation and Maintenance. No special requirements.

2.2.3 CTF CLASSROOM BUILDING

A. General Parameters.

1. Purpose Functions and Capacities. The classroom building houses 14 classrooms and a vending machine area for this project. The building is a one-story building of truckable wood module construction. The building is self-contained with each classroom having its own mechanical system.

2. Visual Appearance. The exterior is of painted textured plywood exterior siding with color coated sliding aluminum windows and painted insulated hollow metal doors. Design is intended to minimize the "trailer" appearance and give an appearance of a more permanent structure.

Interior: Design to normal classroom standards and within the size parameters of Architectural and Engineering Instructions Design Criteria.

3. Number of Personnel. The building is designed to house a maximum of 20 per classroom with 14 classrooms (total 280). Normal classroom occupancy will be 15. The vending area is designed to be able to give one meal to everyone in the complex (maximum total 400 people).

4. Type of Activities. The building houses the classroom functions and food service function of the CTF.

5. Anticipated Life. The facility is designed for a 'T-year life.

6. Type and Method of Construction. The facility is of truckable wood module construction; it is temporary and relocatable with the exception of the foundations.

B. Functional and Technical Requirements.

1. Functional Area

Floor Plan	Occupancy	Area (ft^2)
Classrooms	280	8,400
Vending area	140	1,200
Gross building area		9,600
Net building area		8,800

2. Equipment, Furniture and Furnishings. The following furnishings are provided:

	Quantity	Funding'
Each classroom (14 classrooms)		
Chairs (with writing tables)	16	
Table	1	
Chair	1	
Projection equipment	1	
Projection screen	1	
Trash cans (5-gal)	2	

Vending Area

Trash cans (55-gal)	4
Microwave ovens	2
Refrigerators	2
Vending machines	24 (3-ft-long units)

'Items for which no funding source has been shown will be determined by the Government.

No problems are anticipated with vibration of mechanical equipment or sound transmission between classrooms due to the discontinuous modular construction used in this building.

7. Interior Parking. There are no interior parking or service areas.

8. Physical Security. Keying is a master and submaster systems. Intrusion and fire alarm systems are linked to the main system in the main building.

9. Signage. The building is provided with an identification sign at its entrance. Classroom will have signs indicating the occupancy and identification.

All exits and exit routes have signs to meet the requirements of the building and fire code.

10.' Exterior and Interior Finish Materials. See subparagraph Finish Materials.

C. Design Objectives and Provisions.

1. Adaptation of the Building. The building is special design for this site and forms part of the five-building CTF complex.

2. Organization. The classroom area is arranged so that each classroom can be entered from the outside only. The lunchroom and vending machines are located at the end of the classroom building. Classrooms have individual heating and air-conditioning units.

3. Building Layout. The building is sited so that all traffic will be surrounding the building in a noncrowding distribution. Exterior doors are arranged for access to a vestibule directly from the outside, as a buffer to the classroom. The building is surrounded by open spaces for evacuation purposes and is accessible to emergency vehicles.

4. Consolidation of Spaces. All the noise-producing functions are located together. Lunchroom functions are located together and separated from the quieter classroom functions.

5. Space Layout Compatible with Modular Support Systems. The building layout is designed to accommodate the structural needs of a truckable wood module building. Module manufacturers confirm that the building layout is compatible with their systems.

6. Construction Materials.

Exterior

Walls	Textured plywood on wood framing.
Roof	Metal roofing and siding, factory-color-finished, over plywood on wood framing.
Windows	Sliding double glazed aluminum with a factory color coat finish.
Doors and frames	Hollow metal insulated, 3 ft by 7 ft (pairs as required).

Interior

Floors	Vinyl composition tile to lobbies and vending area carpet to reading rooms.
Walls	Vinyl coated gypsum board.
Ceilings	Acoustical panel lay in grid ceiling.
Doors and frames	Hollow metal, 3 ft by 7 ft.
RVAC system	The HVAC system consists of individual units for each classroom as indicated with individual control for each unit.
Electrical system	The transformer and main switch panel is located in the indicated electrical closet and all circuits will be wired from there.

Selected materials are typical for this type of construction.

7. Building Expandability. The building is of truckable wood module construction and can be easily expanded or reduced by the addition or removal of modules. The interior layout in the classroom areas can be modified, to connect two classrooms into one large one, but modifications in other areas could jeopardize the structural integrity of the modules.

8. Physical Security. The building is not designed as a secure facility.

9. Barrier-Free Design. The facility is designed to be barrier-free.

10. Energy Conservation. Items included to conserve energy are:

(1) Wall insulation R-19
(2) Suspended floor insulation R-19
(3) Roof insulation R-30
(4) Double glazed windows
(5) Insulated hollow metal exterior doors
(6) Draft seals to exterior doors
(7) HVAC system with economizer cycle

11. Acoustical Design. No special acoustical design is necessary.

12. Composition of Masses and Spaces. The building is a simple rectangular shape composed of 16 modules of identical size. The building is designed to be as simple as possible and to minimize maintenance costs.

13. Perception of the Building. The building is designed to be as simple and economical as possible to house the people and functions required. The building is designed to support an industrial training program, and this is reflected in the utilitarian design approach.

14. Enhancement of Materials. Materials are suitable for the type of construction and reflect the limited life span of the building.

15. Economy of Building Construction. The building is designed as economically as possible by choice of construction type, choice of materials, and finishes.

The building should be easy to maintain because all systems and utilities are easily accessed either from inside or below. All exterior materials are easily maintained and should cause no problems for the limited life envisaged for this building.

A modular wood building can be relocated to a new site for very little cost or can be returned to the manufacturer for a substantial rebate. In a short life building such as this the reuse or rebate reflects very favorably on the life-cycle costs.

D. Calculations. See calculations, Volume 3.

E. Coordination with Installation of Outside Agencies.

1. Physical Security Support. The classroom fire protection system is connected to the main system in the main building.

2. Blind Vending Operations. Will apply.

3. Occupational Safety and Health. The building is designed to comply with all OSHA requirements.

4. Government-Furnished Equipment. All hand held fire extinguishers and loose furnishing are furnished by the Government.

5. Signage. The signage is coordinated in style, size, and type with that used for the remainder of the site.

6. Operation and Maintenance. Not applicable.

2.2.4 ADMINISTRATION AND LECTURERS' OFFICES

A. General Parameters.

1. Purpose Functions and Capacities. The Administration and Lecturers' Offices Building houses the administrative staff for this project. The building is a one-story building of truckable wood module construction. The building is self-contained with its own toilets, lunchroom, printroom, and mechanical systems.

2. Visual Appearance. The exterior is of painted textured plywood exterior siding with color-coated sliding aluminum windows and painted insulated hollow metal doors. Design is intended to minimize the "trailer" appearance and give an appearance of a more permanent structure.

Interior: Design to normal office standards and within the size parameters of Architectural and Engineering Instructions Design Criteria.

3. Number of Personnel. The building is designed to house 69 personnel on two shifts with dual use of many of the lecturers' work stations for lecturers on different work shifts.

4. Type of Activities. The building houses the office functions for both the lecturers and administrative staff.

5. Anticipated Life. The facility is designed for a 7-year life.

6. Type and Method of Construction. The facility is of truckable wood module construction, is temporary, and is relocatable with the exception of the foundations.

B. Functional and Technical Requirements.

1. Functional Area.

First Floor	Occupancy	Area (ft^2)
Offices - individual	10	1,010
Offices - open	32	2,204
Administration office	6	428
Conference room (dividable)	16	299
Lunchroom/conference	32	428
Print/Xerox room	2	299
Toilet rooms		363
Mechanical equipment		352
Electrical room		66
Corridors		600

2. Equipment, Furniture, and Furnishings. The following furnishings are provided for Government-occupied spaces.

Item	Quantity
Drafting table	1
Plan file	1
Reproduction machine (Xerox or equal)	1
Blueprint machine	1
Computers/vord processors	6
Desks	71
Chairs	117
Wastebaskets	44
Tables	32
File cabinets	12
Lateral files	12
Refrigerator	1
Microwave	1
Coffee maker	1

3. Occupational Safety and Health. The building is designed to comply with all OSHA requirements.

4. Handicapped Accessibility. Handicapped accessibility is required.

5. Energy Conservation. Insulation values are in compliance with DOD 4270. 1-M and local building code.

6. Sound and Vibration Control. Noise control is not required because the standard construction used reduces the expected equipment noise levels to 35 db or less in the normally occupied areas.

7. Interior Parking. There are no interior parking or service areas.

8. Physical Security. Keying is a master and submaster systems. Fire alarm systems are linked to the main system in the main building.

9. Signage. The building is provided with an identification sign at an entrance. Each floor has signs indicating the occupancy of the floor. Each office and room bas an identification sign.

All exits and exit routes have signs to meet the requirements of the building and fire code.

10. Exterior and Interior Finish Materials. See subparagraph Finish Materials.

c. Design Objectives and Provisions.

1. Adaptation of the Building. The building is of special design for the site and forms part of the five-building CTF complex.

2. Organization. The building accommodations are arranged with the reception area and conference rooms adjacent to the main entrance and opening onto the main office area with the lunchroom and reproduction rooms off the lobby. Adjacent to the reception are are the offices for the chief and deputy chief. Along the side of the open office area are four offices for senior lecturers. At the end of the building opposite the main entrance is an emergency exit. The toilet rooms are located adjacent to the entrance, and separate toilets are located adjacent to the open office area.

3. Building Layout. The building is sited so that all traffic arrives at the main entrance. Exterior doors are arranged for access to mechanical and electrical equipment directly from the outside. The emergency exit and stairway are located on the opposite side of the building from the main entrance. The building is surrounded by open space and parking areas for evacuation purposes and is fully accessible to emergency vehicles.

4. Consolidation of Spaces. All the noise-producing functions are located together and separated from the quieter office functions.

5. Space Layout Compatible with Modular Support Systems. The building layout is designed to accommodate the structural needs of a truckable wood module building. Module manufacturers confirm that the building layout is compatible with their systems.

6. Construction Materials.

Exterior

Walls	Textured plywood on wood framing.
Roof	Metal roofing and siding, factory-color-finished, over plywood on wood framing.
Windows	Sliding double glazed aluminum with a factory color coat finish.
Doors and frames	Hollow metal insulated, 3 ft by 7 ft (pairs as required).

Interior

Floors	Vinyl composition tile generally. Welded vinyl for toilet rooms.
Walls	Vinyl coated gypsum board generally. Fiberglass wall sheathing for toilet areas.
Ceilings	Acoustical panel lay in grid ceiling generally. Gypsum board (WR) painted for toilet rooms.
Windows	Steel frame similar to hollow metal door frames.
Doors and frames	Hollow metal, 3 ft by 7 ft.

HVAC system	The HVAC system will consist of a central packaged unit located in the indicated mechanical room with ductwork located in the ceiling space of the building.
Electrical system	A transformer and main switch panel is located in the indicated electrical equipment room. All circuits are wired from this room.

Selected materials are typical for this type of construction.

7. Building Expandability. The building is of truckable wood module construction and can be easily expanded or reduced by the addition or removal of modules. The interior layout in the open office areas can be modified, but modifications in other areas could jeopardize the structural integrity of the modules.

8. Physical Security. The building is not designed as a secure facility.

9. Barrier-Free Design. The building is designed for use by the handicapped.

10. Energy Conservation. Items included to conserve energy are:

(1) Wall insulation R-19
(2) Suspended floor insulation R-19
(3) Roof insulation R-30
(4) Double glazed windows
(5) Insulated hollow metal exterior doors
(6) Draft seals to exterior doors
(7) HVAC system with economizer cycle

11. Acoustical Design. No special acoustical design is necessary.

12. Composition of Masses and Spaces. The building is a simple rectangular shape composed of nine modules of identical size. The building is designed to be as simple as possible and to minimize maintenance costs.

13. Perception of the Building. The building is designed to be as simple and economical as possible to house the people and functions required. The building is designed to support an industrial training process, and this is reflected in the utilitarian design approach.

14. Enhancement of Materials. Materials are suitable for the type of construction and reflect the limited life span of the building.

15. Economy of Building Construction. The building is designed as economically as possible by choice of construction type, materials, and finishes.

The building should be easy to maintain because all systems and utilities are easily accessed either from inside or below. All exterior materials are easily maintained and should cause no problems for the limited life envisaged for this building.

A modular wood building can be relocated to a new site for very little cost or can be returned to the manufacturer for a substantial rebate. In a short-life building such as this, the reuse or rebate reflects very favorably on the life-cycle costs.

D. Calculations. Not applicable.

E. Coordination with Installation of Outside Agencies.

1. Physical Security Support. The security and fire protection system is connected to the main system in the main building, and this is connected to the base system.

2. Blind Vending Operations. Not applicable.

3. Occupational Safety and Health. The building is designed to comply with all OSHA requirements.

4. Government-Furnished Equipment. All hand-held fire extinguishers and loose furnishing are furnished by the Government.

5. Signage. The signage is coordinated in style, size, and type with that used for the remainder of the site.

6. Operation and Maintenance. Not applicable.

2.2.5 CHEMICAL LABORATORY: Building is under design.

2.3 STRUCTURAL

2.3.1 MAIN BUILDING - GENERAL PARAMETERS

A. Size of Areas/Volumes. The CTF main building is a one-story structure of braced steel frame construction with a mezzanine level and measures approximately 170 ft wide by 302 ft long. For floor loads, see subsection 2.3.2.A, Design Loads.

B. Foundation. The foundation characteristics are based on the Chemical Stockpile Disposal Program, Central Training Facility, Aberdeen Proving Ground, Maryland, Final Foundation Recommendations, Department of the Army, Huntsville Division, Corps of Engineers, Huntsville, Alabama, dated January 29, 1988.

C. Seismic Events, Wind, Storms, and Blast. Wind load governs design of structure over seismic loads because of low seismic intensity activity in the APG area. Loads resulting from storms or blast are not considered.

D. Fallout Shelter. Not applicable.

E. Permanency of Construction. The nature of steel frame construction lends itself to expediency of erection. The planned life of the structure is 7 years.

F. Competitive Structural Systems. the following structural systems were considered:

(1) Concrete building with cast-in-place columns, beams, girders, slabs, and shear walls.

(2) Structural steel building with metal deck, insulated metal siding, and concrete shear walls.

(3) Structural steel-braced frame building with insulated metal siding and roof panels.

2.3.2 FUNCTIONAL AND TECHNICAL REQUIREMENTS

A. Design Loads.

1. Dead Loads. Weight of all supporting and enclosing materials and all equipment, including mechanical and electrical units.

2. Live Loads

Location	lb/ft^2
Floor	
Airlocks	150
Assembly room	100
Boiler room	300
Clothing storage	150
Computer/simulators	150
Control room	200
Corridors	100
Decontamination airlock	150
Decontamination vestibule	150
Demilitarization equipment room	150*
DSA	150
Electrical equipment	150
Electrical maintenance shop	150
Engineering/maintenance	150
Entrance/models	100
Furnace	150
Furnace models	150
Hydraulic maintenance shop	150
Instrument maintenance shop	150
Janitor's room	125

*In addition to a uniform load of 150 lb/ft^2, the demilitarization equipment room and unpack area are subject to a forklift truck with a 15k maximum axle load and 6k maximum capacity, conveyors with a maximum point load of 5k per support (4 ft wide), and conveyors with a uniform load of 1,500 lb/ft.

Location	lb/ft^2
Floor (Contd)	
Life support system	150
Locker rooms	75
Maintenance	150
Mechanical/HVAC equipment	150
Mechanical maintenance shop	150
PAS models	150
Seminar room	100
Showers	60
Storage	150
Suit dry	150
Suit wash	150
Toilets	40
Tools and spare parts	150
Toxic maintenance area	150
Unpack area	150*
Vestibules	100
Mezzanine	
Corridor	100
DFS platform	150
Mechanical/HVAC equipment	150

Location	lb/ft^2
Roof	20

3. Wind load. Basic wind velocity of 70 mph in accordance with ANSI A58.1-1982, Exposure C, importance factor = 1.07.

4. Snow Load. Ground snow load of 20 lb/ft^2 in accordance vith ANSI A58.1-1982, exposure factor = 1.0, importance factor = 1.2.

5. Seismic Load. Earthquake Zone 1 in accordance with TM 5-809-10/NAVFAC P-355/AFM 88-3, importance factor = 1.0. "W" includes 70% of snow load.

6. Impact Factors for Bridge Crane.

(1) Vertical: 1.10 (radio control operated)
(2) Longitudinal: 1.10
(3) Transverse: 1.20

7. Load Combinations. In accordance with TM 5-809-l.

B. Soil Properties. A shallow foundation system consisting of both spread and continuous footings is used. A net allowable bearing capacity of 1,500 lb/ft^2 is used for design. One-third overstress is allowed for wind and seismic loads. Minimum frost depth of 30 inches is used. The following values of settlement are used: long-term settlement = 1 in. or less with a differential settlement of 1/2-in. or less. Refer to final foundation recommendations issued by USAED, Jan. 29, 1988, Ref. CEHND-ED-CS.

The following values are used for calculation of lateral earth pressure:

Soil Type	At Rest	Active	Passive
Granular material	0.5	0.33	3.0
Clay, silt material	0.9	0.8	1.5

Moist unit weight: 125 lb/ft^3

C. Allowances for Future Loads or Expansion. Not applicable.

D. Dynamic Loads. Not applicable.

E. Design Methods. Both the allowable working stress design method for structural steel and the strength design method for concrete are used.

F. Design Stresses.

1. Structural Steel. ASTM A36 in accordance with the AISC Manual of Steel Construction and TM 5-809-4. Yield stress 36,000 psi.

2. Concrete. 28-day compressive strength (f'c) of 4,000 psi in accordance with ACI 318 Building Code Requirements for Reinforced Concrete and TM 5-809-2.

3. Reinforcing Steel. ASTM A615, Grade 60, in accordance with ACI 318 Building Code Requirements for Reinforced Concrete and TM 5-809-2. Yield stress 60,000 psi.

G. Maximum Allowable Deflections.

1. Mezzanine. L/240 for total loads and L/360 for live loads only.

2. Roof. Not applicable.

H. Nuclear Radiation (Fallout) Protection. Not applicable.

2.3.3 DESIGN OBJECTIVES AND PROVISIONS

A. Bay Size. In view of functional requirements and economy, the bay size is 20 ft by 84 ft.

B. Seismic Protection. Seismic forces are resisted by braced frames. The use of a symmetrical framing system was not possible due to functional requirements.

C. Construction of Structural System. The structural system selected is a braced-frame steel building with metal siding and roof panels. Structural steel is selected as the basic framing material because of its economy and flexibility of design and construction. Long spans and need for column-free space made the concrete building with columns and girders or steel building with conrete shear walls very expensive when compared to basic braced-frame steel building.

D. Foundation Design. The foundation consists of a series of spread and continuous footings with provisions for frost protection.

E. Fallout Protection. Not applicable.

F. Speed of Erection. Speed of erection is a significant consideration contributing to the selection of a steel framing system.

2.3.4 CALCULATIONS: See attached calculations, Volume 3.

2.3.5 COORDINATION WITH INSTALLATION OR OUTSIDE AGENCIES

A. Construction Limitations. Coordination of the placement of bridge crane (unable to pass through doors) with the completion of exterior walls is required in order to avoid construction delays.

B. Fallout Shelter Space. Not applicable.

2.3.6 FIREWATER PUMP HOUSE

The firewater pump house is a vendor-supplied prepackaged building with a steel beam grid base. The perimeter beam of the grid is supported on a perimeter spread footing. After installation of the building, the grid beams are encased in concrete to form the floor of the building.

2.4 MECHANICAL

2.4.1 GENERAL PARAMETERS

A. Climatic Parameters.

1. Location:

APG, Edgewood, Maryland
latitude: 39°28'
Longitude: 76’10’
Elevation: 10 ft above mean sea level

2. Outdoor Design Temperature:

Summer (dry bulb): 94°F
Summer (wet bulb): 77°F
Winter (dry bulb): 11°F

3. Wind

Average velocity: 6.8 mph
Direction: WNW generally (SSW from May through August)

4. Precipitation

Maximum monthly rainfall and month: 5.13 in., January.
Average annual rainfall: 30 to 58 in.
Average annual snowfall: 12 in.

B. Competitive Mechanical Systems. During design, in addition to the systems chosen, the following HVAC systems were considered: (a) single package rooftop gas/electric heating and cooling unit, (b) single package rooftop heat pump unit, and (c) fan coil units with central chilled water system.

C. General HVAC Zones and Occupant Capacities. The HVAC systems in the building are split into three main areas:

(1) High bay equipment areas
(2) Computer equipment areas
(3) Remaining occupied spaces.

Occupant Capacities - see Architectural Section.

D. General Toilet/Sanitation Zones. Plumbing systems are designed in accordance with latest editions of all pertinent codes, guides, and regulations of the following, but not limited to:

(Army) military documents
Federal and State regulatory agencies
(NPC) Rational Plumbing Code

The sanitary facilities are based on the minimum occupant capacity requirements as listed for industrial use (Appendix D of NPC), including water closets, urinals, lavatories, and shower facilities; in addition, service sinks and combination emergency shower/eyewash units are incorporated.

The potable water for the facility is supplied from the APG water main from a point 5 ft outside the structure, providing a minimum of 25 psi at the highest, most remote outlet. The potable water supplies all plumbing-related fixtures and mechanical equipment makeup, where required.

The hot water for the facility is provided from two (LPG) heated, storage-type water heaters equipped with a 7-day time clock control, circulating pump, providing 120°F hot water to the lavatories and other plumbing fixtures.

The sanitary drainage system receives waste from the plumbing fixtures, mechanical equipment drains, and gravity flow within the facility to the APG sanitary sewer system.

Each plumbing fixture is vented. Individual vents are collected into a common vent and vented to the atmosphere through the roof.

E. Water Supply Pressure. See Civil Section.

F. Existing or Planned Sanitary Sewer Capacities. See Civil Section.

G. Toxic or Hazardous Pollutant Sources. Not applicable.

H. Functions and Occupancies Requiring Mechanical Lifts. See Process Design Analysis.

2.4.2 FUNCTIONAL AND TECHNICAL REQUIREMENTS

A. Design Temperatures (Indoor).

1. Summer Design Conditions.

(1) All training facility except control room/ simulator area and ventilated space	78±3°F DB
(2) Control room/simulator area 45% ±±% RH	75±2°F DB
(3) Ventilated spaces:	
Electrical room	104°F DB
Mechanical room (boiler, chiller, HVAC)	104°F DB

2. Winter Design Condition.

(1) All training facility except control room simulator area and ventilated space	70 ±3°F DB
(2) Control room/simulator area.	75±2°F DB
Relative humidity	45% ±5% RH
(3) Ventilated spaces:	
Electrical room	50°F DB
Mechanical room (boiler, chiller HVAC)	50°F DB

B. Climate Control.

1. Heating. Two-stage heating is provided: (a) preheat coils in air handlers provide heating of outside air to the predetermined temperature, (b) hot water heating coils for each WAC zone are installed in each variable air volume unit and provide heating for occupancy comfort. Hot water is provided by two 65% boilers which are located in the boiler room.

2. Cooling. Cooling is provided by two 50% reciprocating chillers located in the mechanical room with remote air cooled condensers located outside. The chilled water cooling coils are installed in the air handling units.

3. Humidity Control (For Control Room Only). Humidity is controlled by infrared humidifier, which is installed in the computer room cabinet type air handling units.

C. Mechanical Ventilation and Exhaust System.

1. Fresh air ventilation provision is 10 ft^3/min per person in accordance with ASHRAE 62-1981 (office with nonsmoking occupants).

2. Toilet room ventilation is 2 ft^3/min per ft^2 or 10 air changes/hr, whichever is larger.

D. Control of Airborne-Polluting Substances. Not applicable.

E. Energy Conservation. The air-conditioning units provided are equipped with an economizer cycle so that 100% outside air may be used in the system during cool weather periods (such as spring and fall), when the outside air temperature is sufficiently low to provide all the cooling required. The economizer cycle reduces the load on the air-conditioning equipment. Chilled water system is off when outside temperature drops below 55°F.

F. Control of Polluting Substances from Energy System. Not applicable.

G. Standby Heating and Cooling. Not applicable.

H. Toilet Fixture Allocation. Plumbing fixtures consist of wall-mounted, flush-valve-operated, vitreous china water closets; wall-mounted, flush-valve-operated, vitreous china urinals; wall-mounted with back-splash, front-overflow, armchair-supported lavatories or oval countertop lavatories with 2.5-gal/min, 4-in. center-set faucets; wall-mounted, self-contained mixing valve and 2.5-gal/min restricted head shower assemblies; and floor-mounted, combination emergency shower/eyewash units.

I. Hot and Cold Water Systems Including Recovery System. The potable cold water piping system consists of l-in. insulated-type "L" copper conforming to ASTM B88 and includes wrought-copper solder joint fittings conforming to ANSI ~16.22 (125 psi). All bronze valves, check valves, and regulators conform to ANSI B165.22 (125 psi), soldered with 95/5 tin antimony. Potable hot water piping consists of the same materials as those for cold water and, in addition, a recirculating pump maintains water temperature for long run water usage.

J. Water for Fire Protection. See subsection: UTILITY SYSTEMS.

K. Gas Distribution and Special Liquid Distribution System. See Process Design Analysis.

L. Compressed Air and Vacuum Production Components. See Process Design Analysis.

M. Sanitary Waste and Vent Piping. Sanitary pipe above the floor is service weight, no hub, and is used for soil, waste, and vents within the building.

Below-floor sanitary pipe within the building and to point of connection 5 ft outside building is service weight, hubbed with neoprene compression joints, double asphaltum coated.

All cast-iron service weight piping conforms to ASTM A 74.

N. Acid Waste Piping and Neutralization. Not applicable.

O. Disposal of Toxic and/or Polluting Substances Within This Facility. All toxic substances are collected through sumps and disposed of into the simulated spent decon system or collected by tanker truck. No toxic substances are allowed into the sanitary sewer system.

P. Coordination with Connection to Site Utilities. See subsection: EXTERIOR UTILITY SUPPORT SYSTEMS.

Q. Cranes and Hoists. All cranes and hoist within the CTF are electrically operated. Cranes and hoists have radio pushbutton controls for hoist, trolley, and bridge drives. Monorail hoist trolleys have rigidly mounted, standard I-beam track, with route as shown on the general arrangement drawings and curves suitable for the trolley selected.

All cranes and hoists have sufficient wire rope to reach the floor from the installed height. Rated load capacities are shown in the equipment list.

R. Handicapped Accessibility/Features. See subsection: HANDICAPPED ACCESSIBILITY.

2.4.3 DESIGN OBJECTIVES AND PROVISIONS

A. Benefits from Natural Warming and Cooling Effects. Economizer packages are provided on HVAC systems for natural cooling [see Section 2.4.2.E.

B. Zoning of HVAC by Occupancy. Not applicable.

C. Heating and Cooling System Design. Heating and cooling in the CTF building (with exception of control/computer room and unpack/demilitarization area) are provided by single duct variable air volume (VAV) system. The supply air from two 50% air handling units are maintained at constant temperature, which varies with the season. The individual zone thermostat varies the air supply quantity to each zone through the VAV box to maintain the design temperature conditions. The zone thermostat controls the the VAV damper to its minimum setting of 50% of design airflow (to provide sufficient ventilation) and then starts to open the heating valve if heating is required. Two 65% No. 2 fuel oil energy source boilers provide hot water for space heating. Two 50% reciprocating chillers with remote air cooled condensers provide chilled water for space cooling. Control/computer rooms HVAC system is equipped with a cabinet-type air handling unit fitted with an infrared humidifier, electrical heating coil, and direct expansion cooling coil with air cooled condenser unit located outside.

Constant-flow chilled water system and constant-flow hot water system with three-way valves at the coils are used because it is the simplest system to operate and control. A variable-flow system would reduce the operating cost, but require additional pumps and controls and cost more than the constant-flow system. The higher cost and increased space requirement are not justified by the lower operating cost over a 'I-year operating period.

D. System Expandability and Feasibility. No provisions are made for future expansion of the building. The plumbing system as designed conforms to the minimum requirements to maintain sanitary facilities and life safety.

System sizing, based on code requirements, exceeds the minimum fixture loading; thus allowing for future expansion, additional fixtures, and mechanical equipment.

The HVAC system is designed to provide continuous personnel comfort and maintain the space at design conditions.

E. Energy Conservation. Economizer cycle packages, night time temperature setback, and morning 100% recirculation warmup are implemented in the WAC system.

F. Vibration/Noise Isolation. Steel spring vibration isolators are provided with the air handling units. Flexible duct connectors are provided at the intake and discharge of all fans and air handling equipment to reduce transmission to the duct work and the building. Sound attenuators and duct linings are provided for sound control in the air condition space.

G. Consolidation of Toilet/Sanitation Facilities. Not applicable.

H. Supply and Waste Piping System. The copper potable water system is designed to meet all sanitary and fire code requirements, is not affected by pressure surges, will accept extreme temperature variations, and requires little or no maintenance.

The cast-iron sanitary drainage system, designed for a flow of 2 ft/sec, is a code-acceptable system for use within and under structures, is economical, and requires little or no maintenance.

I. Connection to Utilities. The potable water terminates 5 ft from the exterior face of the structure, where it is interfaced by the site utility system, continues in the same material, and ties to the downstream side of the domestic water meter. Where the meter is within the 5-ft limitation, plumbing contractor is to make the interface connection.

The cast-iron sanitary waste line terminates 5 ft from the exterior face of the structure, where it interfaces with the site utility system, and continues with the same material or changes to conform to the material used for site drainage. The structure drainage is installed with a building isolation valve in a dry well at or within the 5-ft limit, with upstream/downstream pipe connections. The downstream stub allows enough pipe for making a connection for continuation to the site system. The sanitary vents for 2 in. and larger are cast iron; those under 2 in. are of galvanized steel. Sanitary vents are extended a minimum of 10 in. above the roof with frost closure. Vents under 3 in. in diameter are increased in size, to 3-in., 1 ft before the roof penetration.

J. Control of Polluting Substances. Not applicable.

K. Mechanical Lift Design. Not applicable.

L. Systems Maintenance and Operation. Not applicable.

M. Economy of Construction. All selected mechanical equipment are standard size and shelf items.

2.5 FIRE SAFETY

2.5.1 GENERAL PARAMETERS

A. Types of Occupancies. The occupancy classification (B2, A3) of the building or portions of the building is based on use in accordance with the UBC. Additional occupancy requirements are in accordance with the standards and recommended practices of such authorities as NFPA, FM, MIL-HNDBK-1008, and other military publications.

B. Separation of Structures. Special considerations are given to proper area separation, in accordance with the UBC and NFPA requirements. Fire rated walls are included at all exit corridors, boiler rooms, and furnace rooms.

C. Firefighting Support. Firefighting support is available from the APG base fire station to aid the building fire detection, automatic fire suppression systems, and portable fire extinguishers provided throughout the building to control any outbreak of fire.

D. Presence of Handicapped Occupants. Students are required to be able-bodied by the needs of the project; however, the facility is designed to be handicapped-accessible.

2.5.2 FUNCTIONAL AND TECHNICAL REQUIREMENTS

A. Construction for Fire Resistance. Construction is Tyoe II N per UBC code with fire rated walls to exit corridor, boiler room, and furnace rooms.

B. Type of Occupancy. B II and A III.

C. Smoke and/or Heat Detection Systems. Detectors are provided in all areas of the CTF, including corridors, offices, shops, and mechanical equipment room. Above- and below-floor detection systems are provided in areas with computer floors.

Smoke-actuated detectors operate on the ionization principle.

Heat-actuated detectors are of the rate compensation/fixed temperature type and are designed to operate when the temperature reaches a predetermined value and/or when the temperature rise exceeds a predetermined rate (usually 15°F to 20°F/min regardless of the temperature level).

All the detectors are independently supervised and connected to local audible and visual alarms. When detectors are actuated, a building alarm sounds and a noncoded signal is transmitted to a constantly monitored control panel located in the reception station of entrance hall.

D. Smoke Evacuation and/or Containment System. Not applicable.

E. Automatic and/or Manual Fire Alarm System. The fire alarm system is designed in accordance with applicable requirements of NFPA Standard 72D, NFPA Standard 1221, and Army Regulation 420-90. A fire alarm and signaling system is provided complete with conduit, wiring, and equipment and is capable of providing the following:

1. Automatic supervision of alarm initiating circuits.

2. Automatic conditioning for transmission of signals under line fault conditions or single ground, single open, or both.

3. Permanent record of alarm signal, time, and date.

4. Transmission of coded signals to APG base station and fire department.

5. Automatic testing of radio signaling devices.

The fire alarm and signaling system is fully supervised with manual stations, detectors, and audible signals throughout the CTF.

Activation alarms are provided for all fire suppression systems and manual pull stations. The fire detection system provides a local and transmitted signal to indicate operation of system(s).

The local alarm and control panels are designed and approved for the system with which they are to be used. They are installed in a convenient nonhazardous location where they are not subject to mechanical injury or tampering.

F. 'Automatic Fire Extinguishing Systems. The fire suppression system requirements are summarized as follows:

1. Sprinkler System. The automatic sprinkler system is an integrated system of overhead piping designed in accordance with fire protection engineering and military standards.

Fire service water is supplied to the CTF building from a water system loop (see subsection EXTERIOR UTILITY SUPPORT SYSTEMS) (1,100 gpm at 70 psi).

A complete wet-pipe sprinkler system, including piping, valves, fittings, sprinkler heads, and all required attachments and devices, to provide a hydraulic water motor alarm, an electronic alarm, and supervisory signal to the main fire protection panel is installed throughout the CTF building.

The system is activated by heat from a fire and discharges water over the fire area.

Operation of the wet-pipe sprinkler system is as follows:

When a sprinkler activated by a high temperature opens in a wet-pipe system, water discharging from system lifts the clapper from its seat in a main alarm valve and opens the auxiliary valve.

Water flows through the auxiliary valve to the retard chamber, closing the pressure switch which activates the electric alarm.

Flow through a water-flow indicator (located on each floor) also activates the electric alarm.

During surges or pressure fluctuations, the clapper in a main alarm valve opens momentarily, trapping small amounts of water into the auxiliary valve and retard chamber, preventing a false alarm from water pressure surges.

Sprinklers for offices, corridors, and other finished areas are UL-listed and/or FM-approved recessed chrome-plated pendant type with a standard 1/2 in. orifice size and chrome plated trim rings. Heads are installed in upright position except areas indicated.

The temperature of the sprinkler heads shall be 165°F except near heat sources where temperature rating are in according with NFPA No. 13.

Minimum operating pressure of any sprinkler is required to meet the proper density. An additional 500-gpm water supply is included in the design for inside hose stream requirements.

Fire stopping material is provided for closing pipe and conduit penetration in fire-resistive structural partitions.

Fire department connections are provided as secondary water supply to the installed sprinkler system.

2. <u>Halon 1301 System.</u> Halon 1301 is used in a total-flooding system designed to suppress electrical and other fires in the CON.

The CON has above and below floor Halon protection. Halon 1301 systems are designed in accordance with NFPA 12A, 72A, and 72E. The system provides a concentration of Halon 1301 between 5% and 6% by volume at 75°F. With a full-capacity connected reserve agent supply for protected areas. The total discharge time does not exceed 10 seconds. The system design includes the capacity to automatically maintain the Halon concentration for a minimum of 10 minutes.

System actuation is provided by cross-zone, above and below floor ionization detection system, and/or manual pull stations.

An abort switch is provided from a Halon protected area to manually stop an automatic dump.

UL-listed and/or FM-approved components are used for Halon 1301 systems.

3. <u>Fire Extinguishers.</u> Government-furnished portable fire extinguishers are located and installed throughout the CTF in accordance with NFPA 10. Halon extinguishers are provided in the electrical equipment, and mechanical equipment rooms. All other extinguishers are of the multipurpose dry chemical type.

G. Standpipes and Hose Systems. Class II hose stations are provided throughout the CTF building for first-aid fire fighting capability. All fire hose stations are installed in compliance with NFPA 13, NFPA 14, and MIL-HDBK-1008 for combined systems. All fire hose cabinets are sized to house and be provided with A-B-C multiple-purpose dry chemical fire extinguisher in addition to hose and appurtenances.

H. Resistance of Interior Finishes and Materials. Not applicable.

2.5.3 DESIGN OBJECTIVES AND PROVISIONS

A. Zoning and Treatment. The CTF is designed to be fire resistive and use noncombustible materials (UBC Class II N). Process procedures, materials, and equipment may cause fire hazards (such as the burner train assembly and boiler rooms) . These areas are surrounded by fire rated constructions in accordance with code requirements.

Based on occupancy classification (B2 and A3) and fire hazard evaluation, the CTF is divided into 24 zones in accordance with NFPA 72A, 72E, 72D, and 101 and as shown on the drawings.

Life safety is a prime consideration; fire detection, alarms fire suppression, and facility evacuation routes are planned: first, to protect the personnel; second, to protect the high value of the facilities; and finally, to minimize adverse programmatic effects.

A combination of sprinkler, standpipe, and Halon systems are provided for appropriate areas of the main building. Sprinklers are provided generally throughout the building except at the control room areas, which are Halon protected. Class II standpipes are provided at strategic positions throughout the facility.

B. Alarm, Detection, and Smoke Control.

1. Detection System. The CTF building is furnished with different types of detectors based on evaluation of the potential hazards.

a. Smoke Detectors, Ionization Type. Smoke detectors utilizing the ionization principle are of the spot type. The detector is capable of detecting the presence of both visible and invisible particles of combustion and is more sensitive to invisible particles.

A minimum number per unit volume of smoke particles are required to activate an ionization detector. An ionization smoke detector has a small amount of radioactive material that ionizes the air in the sensing chamber, thus rendering it conductive and permitting a current flow through the air between two charged electrodes. This gives the sensing chamber an effective electrical conductance. When particles of combustion enter the ionization chamber, they will attach themselves to the charged particles and reduce their flow.

When the conductance is less than a predetermined level, the detector responds.

b. Heat Detectors. In the combination rate-of-rise and fixed temperature unit, the fixed temperature element is independent of the rate-of-rise element. In a slowly developing fire, the rate-of-increase of temperature may be below the 15°F per minute setting. When the fixed temperature element is heated to its rated temperature, the bimetallic element is flexed to close the contacts and signal an alarm.

2. Alarms. General requirements: Activation alarms are provided for automatic sprinkler systems, special fire suppression systems, and fire detection systems to provide a local and transmitted signal to indicate operation of system or systems.

Local alarm: Manual fire alarm pull stations are provided near each main exit. In simulated toxic areas or high noise areas, the local alarm is visible as well as audible.

Bells and/or horns sound when the fire alarm system is activated through fire alarm stations or automatic fire detection devices.

3. Annunciation and Smoke Control. The fire alarm system automatically initiates fire alarm signals whenever any manual or automatic fire detecting devices are placed into an alarm mode. The system indicates areas of zoned annunciation and at the same instant selectively deactivates HVAC fans, transmits a signal to the control panel, and sounds local alarms. Alarm signals are consistent throughout the building. The operation of any alarm-initiating device in a building causes an alarm to sound throughout that building. Manual and automatic stations transmit noncoded alarm signals without interference.

a. Evacuation Alarms. Noncoded evacuation alarm: In the building a fire alarm signal is employed for notifying the occupants to evacuate. An annunciator indicates the specific location of the fire. A building noncoded fire alarm signal is sent to the control panel.

b. Trouble Signals. During abnormal conditions such as an open wire or a ground fault, or where both conditions occur at one point, the system is capable of automatically transmitting clear, intelligible, trouble signals in response to activation of the positive, noninterfering building fire alarm transmitters.

C. Systems Economy, Testing, and Maintenance.

1. System Economy. Automatic fire extinguishing and detection systems are designed in an economical way to meet the requirements of NFPA and military standards.

2. Testing and Maintenance. After installation, the testing and inspection of all fire extinguishing and detection systems are conducted in accordance with applicable sections of NFPA. The Contractor performs the tests in accordance with the procedures approved by the Contracting Officer.

A training program is provided by the Systems Contractor for CTF operating personnel in operations and maintenance requirements.

D. Antivandalism. All the components of the fire extinguishing and detection systems are protected from vandalism. Switches and other controls are not accessible without the use of a key. Access to controls by unlocking and opening a panel or door. Locks for all cabinets are keyed alike.

E. Efficiency of Fire Safety Features. Building exiting systems are sufficient to evacuate the building in less than 2 minutes as required by normal fire safety standards. Exits are provided at both ends of the central corridor and directly from the assembly room and entrance areas. Additional exits are provided in the DER and the furnace PAS and BRA model areas, as well as from the center of the main corridor. The width of exits included is more than twice the recommended design minimum.

The building is totally covered by automatic fire suppression systems; in addition, Class II fire hoses are provided at both ends of the central corridor amd at other strategic locations within the building to provide full coverage.

2.5.4 COORDINATION WITH INSTALLATION OR OUTSIDE AGENCIES

A. Firefighting Support. The selected fire alarm system is directly connected to the local fire department by a supervised telephone circuit, so that trained firefighting personnel can respond as rapidly as possible to the fire location.

The tie-ins with the local fire department alarm and annunciation system are in compliance with the requirements of NFPA 72A, 72B, 72C, and Corps of Engineers requirements.

B. Adequacy of Water Supply, Including Flow Tests. Water is supplied from a reservoir at Winter's Run that feeds storage tanks in the Edgewood area, which will accommodate potable/process water and maximum reasonable fire water demand.

Upon completion and prior to acceptance of the installation, the Contractor performs all required acceptance tests, including the flow test as required by NFPA 13, and forwards the certificate(s) to the authority having jurisdiction prior to asking for approval of the installation. The tests are performed in the presence of the authority having jurisdiction.

C. Testing of Systems Performance. The Contracting Ofifcer reserves the right to inspect each phase of installation of any fire protection system.

The entire detection, alarm, actuation, and all fire extinguishing systems are inspected and tested in accordance with the applicable sections of NFPA. The operation and performance of all systems functions are also demonstrated.

2.6 ELECTRICAL

2.6.1 GENERAL PARAMETERS

A. Codes, Standards, and References. The electrical design conforms to the applicable requirements of the following:

(1) National Fire Protection Association (NFPA) - National Electrical Code (NEC) 1987

(2) National Electrical Safety Code (ANSI C2)

(3) Occupational Safety and Health Standard8 (OSHA)

(4) National Fire Codes (NFC) 1988.

(5) Illuminating Engineering Society (IES) Lighting Handbook

The electrical system protective devices will be coordinated to interrupt only the faulted circuit, as far as possible.

Applicable standards listed in the specifications will be used for establishing quality of materials and equipment.

B. Power Service. Electric power will be supplied from an existing 34.5-kV overhead line. The power service voltage to the facility will be 34.5 kV, three-phase 3 wire, 60 Hz. The outdoor type substation will transform the incoming line primary voltage to 480Y/277 volts. Switchboard for the 480Y/277 volt power service will be the indoor type and will be the main power distribution center. The point of interface between building electrical systems and sitework is 5 ft outside the building wall.

1. Electrical Loads. The estimated connected load and estimated maximum demand of the plant are shown below:

Load Description	Estimated Connected Load (kVA)
Material handling and process system	594
Facility support equipment and HVAC	810
Lighting	99

The estimated maximum demand is not expected to exceed 1,052 kVA (based on 805 load power factor and 70% estimated demand factor).

2. 480/277-Volt and 208Y/120-Volt Distribution. 480/277-volt feeders extends from the power distribution section to loads and to motor control centers. Circuit breakers are provided for overcurrent protection. Dry-type transformers are provided to reduce the 480-volt power to 208Y/120 volts for utility outlets and incandescent lighting and for miscellaneous 120-volt loads. Ground fault protection is provided in accordance with NEC. Bus is copper and braced to withstand available short-circuit current.

3. Communications. Communications are addressed in the Process Design Analysis.

2.6.2 FUNCTIONAL AND TECHNICAL REQUIREMENTS

A. Electrical Equipment and Installation. Electrical equipment installed outdoors and in the toxic maintenance area is in weatherproof enclosures. Electrical equipment and installations in other areas are general-purpose types in NEMA Type 1 enclosures, as a minimum.

Electrical equipment and installation in the hazardous areas are suitable for hazardous location with Class, Group, and Division, as indicated.

B. Feeders. Feeders are sized in accordance with NEC and COE directives regarding demand and diversity factors. Feeder circuits are run in rigid steel conduit.

1. Motor Circuits. Motor circuits for special-duty and other motors (cranes, hoists, etc.) conform with the applicable requirements of the NEC; in no case is the recommended rating or setting of overcurrent devices to be exceeded.

2. Feeder Overcurrent Devices. The load on feeder overcurrent devices is limited to 80% of their rating to ensure against unnecessary feeder outages caused by high ambient temperatures within panelboards and similar nonventilated enclosures. Allowance is made for long continuous loads per NEC Article 220.

C. Branch Circuits.

1. Lighting and Appliance Branch Circuits. These circuits are not supplied from a panelboard with mains rated in excess of 225 amperes. Circuits are rated at not less than 20 amperes, except that 15-ampere circuits are utilized when required by specific loads. Special-purpose circuits are designed to meet load requirements.

Design of branch circuits is such as to employ to full advantage the three- or four-wire distribution system by combining single-phase loads on common neutrals and installing conductors in common raceways. Circuit breakers are not loaded to more than 80% of trip rating. (This may be increased if ambient-compensated breakers are used; however, compensated breakers are not available in all sizes and interrupting ratings and availability must be checked before requiring compensated breakers.)

2. Motor Circuits. Small motors are serviced directly by one branch circuit, provided rating does not exceed 20 amperes.

3. Load Identification. Extreme care is taken to ensure that proper service is provided for all electrical loads and that all electrical loads are properly identified on the drawings.

4. Services for Other Equipment. Electric service to equipment furnished and installed under other sections of the specifications includes all necessary disconnect switches and power and control wiring. (Controllers and factory-

wired control wiring are furnished with equipment in conformance with the appropriate section of the specification.)

D. Voltage Drop. The combined voltage drop on feeders and branch circuits for wiring systems within buildings does not exceed approximately 5%. Approximately 2% drop is apportioned to the feeders and 3% to the branch circuits.

E. Grounding System and Lightning Protection. The grounding system is in accordance with NEC and as discussed herein.

1. Neutral Conductor. The neutral conductor of the 480Y/277-volt service is grounded at the substation transformer and the power service equipment in the facility. The neutral conductor of the 480-208/120-volt transformer is grounded at the transformer.

2. Transformer Neutral. The transformer neutral of the grounding conductor is connected to the electrical ground system at transformer or main switchboard. The ground resistance of the grounding system does not exceed 5 ohms.

3. Miscellaneous. The electric motor frames, ground terminals of general-purpose receptacles, and special-purpose receptacles are grounded by means of a separate grounding conductor installed in the conduit enclosing the branch circuit conductor serving the motor or receptacle. Metal enclosures of switchboard, motor control centers, lighting panel cabinets, and the transformer frame are grounded and connected to the electrical power system ground. Metal raceways, sheaths, cable trays, and other noncurrent-carrying metal parts of electrical equipment are grounded.

4. Instrumentation Ground. A separate and insulated instrumentation grounding system with a single-point connection to the electrical power grounding system is provided.

5. Grounding Grid. The grounding system consists of ground rods and No. 4/0 AWG bare copper cable interconnected to form a grid of all electrical equipment and building steel. The equipment connections are No. 2 AWG or larger, as required by IEEE standards.

6. Connections. All connections to building steel are made with the exothermic-type welding process; soldering or brazing is not used. Other above-grade connections are made with bolted solderless connectors.

Instrument enclosures connected to metallic conduit are considered properly grounded. Where provided, the shield drain wires of the instrumentation cables are insulated and float on one end. The shields or drain wires for instrument milliamp signals are grounded only at the control room, while drain wires for the thermocouple signals wiring are grounded at the thermocouple only.

On the floating end of drain wires, the insulating bushing are longer than the exposed portion of the drain wires to prevent accidental grounding. Floating drain wires are left long enough so they can be connected to ground if necessary.

7. Lightning Protection. Lightning protection conforms to the National Fire Protection Association Standards and NEC. The lightning protection system is bonded below grade to the grounding grid installed around the building.

F. Wiring. Wiring is in accordance with the NEC and as indicated in the following paragraphs.

1. Raceways. Raceways below floor or underground and conduit exposed to weather are galvanized, rigid-steel. Flexible conduit is used for short connections to vibrating and rotating equipment; in wet locations, flexible conduit is neoprene-jacketed. Underground rigid galvanized steel conduit is wrapped with PVC tape or coated.

2. Conductors. Conductors for branch circuits are not less than number 12 gage and provided with 20-ampere overload protection. Larger conductors are used for branch circuits where loads exceed that permitted on 20-ampere circuits or where it is required that the voltage drop be maintained within the above described limits. Conductors for feeders are designed in accordance with the connected load to which a suitable demand factor is applied and allowance is made for possible future increase in load. The voltage drop on medium-length and long feeders is checked to ensure that the above described limits are not exceeded. Conductors for 480 volts and below have 600-volt insulation, are rated at 90°C, and are heat- and moisture-resistant, Type XHHW. Where special conditions exist, higher grade insulation suitable for the application is specified. No. 10 AWG and smaller conductors are solid copper, except where stranded wire is required to provide flexibility. No. 8 AWG and larger conductors are stranded. All conductors are copper and color-coded per Article 210 of the NEC.

3. 'Wire and Cable Sizing. In selecting cables and determining their ampacities, the following factors were considered:

(1) Load factor of 100$ for power cables and 125% of full-load current for motor feeders.

(2) Environment ambient temperature

(3) Physical installation

(4) Short-circuit current

(5) Environmental chemical exposure

(6) Fire resistance

(7) Electrical noise pickup and limitations, where applicable

4. Cutlet Boxes. Cutlet boxes are not less than 4 inches square or octagon and for exposed work in rigid or metallic tubing are of the screw-hub type.

5. Conduit and Fittings. Conduit and fittings, including junction and outlet boxes, are galvanized finish.

6. Supports and Fasteners. Standard practices for conduit systems supports and fasteners are used as prescribed by the NEC. Supports and fasteners subject to seismic events are in accordance with the seismic requirements of the structure.

G. Motors and Motor Control. Motors of less than 1/2 hp are rated 120 volts, single phase, 60 Hz. Motors from 1/2 hp to 200 hp are rated 460 volts, three phase, 60 Hz. Motors located outdoors are totally enclosed and fan-cooled. All other motors are *standard dripproof. Motors 5 hp and above are furnished with capacitors to improve power factor.

1. Control. Motors are started from programmable logic controller (PLC) or local control stations. Motor control circuits are 120 volts.

2. Motor Control Centers. Motor control centers (MCCs) are provided for three-phase motors. The MCCs are rated 480 volts, three phase, 60 Hz. Starters for motors up to 200 hp are combination motor-circuit-protector, across-the-line type. All starters are equipped with three overload relays. MCCs will be NEMA Class II, Type B, with copper bus braced to withstand available short-circuit current. Individual control transformer are provided for each motor starter.

I. Transformers. Transformers are the general-purpose dry type for indoor use. The kV-A rating, primary and secondary voltages, number of phases, and type of connection are specified in the final design. Insulation will be Class F with 115°C temperature rise for 15 kVA or less, and Class H with 150°C temperature rise for transformers larger than 15 kVA. Transformers have two 2.5% taps above and below normal rated voltage. Transformers installed outdoors are in weatherproof enclosures suitable for outdoor installation. Transformer impedance is specified in the design and will limit available short-circuit current.

J. Panelboards. Lighting and power-distribution panelboards are provided in accordance with area load requirements. Lighting panels are the dead-front type and will be surface mounted. Power-distribution panelboards are the free-standing type.

Protective devices are circuit breakers with magnetic short circuit and thermal overcurrent trip devices. The 480-volt distribution and lighting panels are rated 480Y/277-volt, three-phase, four-wire with separate neutral and ground bus.

Lighting and power panels have a minimum of 10% spare spaces for future additions, complete with main bus sized for the future breakers.

K. Power and Convenience Outlets. All areas are provided with a sufficient number of receptacles with the proper characteristics to fill all requirements adequately. Receptacles are polarized with one pole effectively grounded. Circuits for receptacles in normally wet or damp locations are provided with ground fault protection for personnel safety, per NEC Article 215.

1. General-Purpose Convenience Receptacles. These receptacles are duplex two-wire, three-pole grounding type, rated 15 amperes, 125 volts, unless otherwise noted. The third grounding pole is connected to the grounding yoke by means of a separate green-colored grounding conductor. Convenience outlets are installed at convenient intervals in corridors and large rooms for the operation of maintenance equipment such as floor waxers, cleaners, sanders, or polishers. In areas where a relatively large number of outlets are required along a wall or bench line, wiring channels with single receptacles mounted therein are provided.

2. Special-Purpose Receptacles. Receptacles for welding transformers will be provided in required locations. The grounding pole will be connected to ground bus at the panel by means of a separate green-colored grounding conductor.

3. Clock Outlets. Clock outlets will be provided as required.

L. Lighting.

1. General Illumination. In general, 277 volts is used for high-pressure sodium and fluorescent lighting. In some cases, the lighting system is 120 volts when incandescent fixtures are used. Local switching is provided on all interior lighting circuits.

Fluorescent lighting fixtures are used in areas where continuous work is to be performed, such as offices, control rooms, and corridors. Fluorescent fixtures in these areas have prismatic lenses and rapid-start lamps. Fluorescent fixtures in mechanical and electrical rooms are the industrial type with rapid-start lamps. Fluorescent lamp ballasts are the thermally protected, Class P, CBM-certified, high-power-factor type.

2. Emergency Lighting. Emergency lighting is provided for safe egress during normal power outage. The emergency lighting is automatically switched to emergency power upon loss of normal power and consists of battery-operated lighting units. Emergency lights are used at stairways, corridors, control room, and process areas. All wiring of the emergency lighting system conforms to the applicable requirements of Article 700 of the NEC.

3. Outdoor Area Lighting. General-purpose area lighting for parking areas and lighting in outdoor and night operational areas is high-pressure sodium units. Lighting is photoelectrically controlled.

4. Illumination. The lighting system is based on the intensities indicated in Table 2-l These represent in-service values after a maintenance factor of 0.70 has been applied. In air-conditioned or pressurized space, a maintenance factor of 0.85 is used. The values are average horizontal footcandles over the location described on a horizontal plane 30 inches above the floor, ground, or platform.

5. Exit Lighting Fixtures. Exit lights and signs are combined in an internally illuminated fixture with translucent globe or letters, as approved by the Underwriters Laboratories, Inc. for this service.

Table 2-1 - Light Levels

Work Area or Type of Task	Minimum[a] (fc)
General work and handling	75
Areas requiring CCTV	75
Control room operations	
Console surfaces	50
Panels, front/rear	50/30
Computer operations	100
Recording	75
Transcribing and tabulation	100
Circuit diagrams	100
General office work	70
Ambient lighting	50
Reading dials, gages, meters, and scales	50
Benchwork, medium detail (DPE support area mechanical, electrical, and hydraulic maintenance shops)	75
Inspection vork and testing (maintenance shop)	100
Repair work, general	50
Storage, live medium (DPE storage area)	53
Corridors, stairways, passageways	20
Emergency lighting	3

[a]Where ambient lighting does not meet minimum footcandle requirements to perform tasks, supplementary lighting is provided. In areas requiring CCTV, the light-to-dark ratio does not exceed 6:1.

M. Hazardous Locations.

1. Equipment in Hazardous Locations (e.g., next to fuel oil or LPG equipment). Electrical equipment, lighting fixtures, and devices meet the classification requirements of Article 500 of the NEC for hazardous locations and are approved by Underwriters Laboratories, Inc.

2. Location of Areas. The drawings and specifications indicate the extent and classifications of the hazardous areas.

N. Public Address (PA) System. A completely operable system is installed in the main building, laboratory, classroom building, and administration building. It is designed to provide normal public address messages and emergency messages. The system is designed with following design guidelines.

1. The system consists of all solid-state devices and represent the most current state of the art in concept and engineering.

2. The system is designed to provide a sound level of about 25 db above the ambient building noises. Critical locations include auxiliary speakers as required. In areas where the ambient noise is 85 dbA (e.g., mechanical equipment room), the PA messages are normally not intelligible, and the system is designed to provide good messages at the next lower ambient sound level of 65 dbA.

3. The speakers are on separate circuits of a power amplifier, so that if one circuit is not operating, the next circuit can cover the areas of the nonoperating circuit. In this manner, the message volume may be reduced, but the message is not completely lost.

4. The speaker cables are 16 AWG audio cables in conduit.

5. There is enough reserve power for PA use in case the main power fails in an emergency.

0. Local Area Network (LAN). The LAN ties the main building, laboratory, and the'administration building for data transmission. In addition, another data transmission path will be provided between CTF and the base.

Telephone and PABX are the main transmission paths linking various buildings and between CTF and the base and support the following data transmission rates:

Analog data = 19.2 kbps
Digital data = 56 kbps

Proper modems shall be provided by the Client so that various data-transmitting equipment, e.g., personal computer and data terminals, may fully utilize the telephone/PABX system.

No future coax LAN cable is anticipated.

P. Support Radio and Paging Radio (Beeper). The radios will be used to support the CTF operations and will consist of two-channel 450-MHz band radios. The support radio is a two-way radio, and the beeper is a one-way tone/voice radio.

The radio system is designed with the following design guidelines:

1. Coverage - within the CTF boundary

2. The support two-way radio is accessed from the radio console and selected telephone sets. Radio-to-telephone access can be achieved via the operator. The beeper can be accessed from selected telephone sets.

3. The antenna 'cable is a 1/2-in. coax foam dielectric cable, and the antennas are a high-gain type and mounted on the roof of the main building.

4. A simplex radio channel is included for communication among hand-held radios in case the main base radio fails.

Q. Telephone. The telephone system is used among the various buildings and between the CTF and the base. The major equipment includes a 100-line private automatic branch exchange (PABX), main distribution frame (MDF), and various telephone sets. A 100-pair cable inter-ties the CTF PABX and base PABX. The service trunks include Federal Telephone System (FTS), tie, direct inward dialing (DID), and central office. Dedicated services include local area network, support radios, public address, DPE radios, and facsimilies.

The design is based on following guidelines:

1. Cable to each telephone set is a 4-pair 22 AWG telephone wire with a polyethylene jacket.

2. All telephones are wired from telephone junction boxes (TJB). Extension telephones will be interconnected at the TJB.

3. All cables are in conduits.

R. Assembly Room Sound System. The assembly room sound system is used mainly for giving speeches and lectures. The system is designed using the following guidelines:

1. The system is designed using the performance requirements and goals as set forth in the specification.

2. Speech intelligibility is of the utmost importance. All equipment used and environment is designed to achieve this goal.

3. The system interfaces with one or more of following inputs: lecture/speech as given by the orator on stage and projector (either overhead, slide, or movie). The speaker output is broadcast to an audience of 100 to 300 persons.

S. Fire Alarm. The fire alarm system is provided by the heating, ventilation, and air-conditioning discipline. However, in case of fire alarm, the alarm signal is transmitted to the base fire station via radio transmission. The exact interface and design will be defined after The Ralph M. Parsons Company receives the details of the existing system.

T. Intercau. The intercom was listed in the PDB. However, since the CTF is for training purposes, the system is deemed unnecessary and, therefore, is not provided for the main building.

U. Electrical Testing. Tests and checks are specified to be made on all electrical equipment and wiring to ensure compliance with the applicable codes, standards, design, and approved shop drawings to give the Client an operable and trouble-free installation. Whenever possible, tests are specified to be made for 'insulation resistance, grounding resistance, ground circuit continuity, phase rotation, loose connections, circuit continuity, equipment nameplates, mechanical defects, correct control wiring, and setting and testing of protective devices just prior to energizing the equipment or circuits. Test records are to be made and turned over to the Client upon completion of the work.

SECTION 1

GENERAL DESCRIPTION

1.1 PURPOSE

This design analysis contains a description of process functional and technical provisions along with the supporting calculations for the Central Training Facility (CTF)[1] located at Aberdeen Proving Ground (APG), Edgewood, Maryland, as part of the Chemical Stockpile Disposal Program (CSDP). The analysis is intended for use in the review and approval of the design drawings for the CTF site and to assist in the revision of the design during construction, as required.

1.2 AUTHORIZATION

1.2.1 DIRECTIVES

This document is prepared in accordance with Modification PZ0001 to Contract DACA87-86-C-0084, Appendix A, Title 1, awarded to The Ralph M. Parsons Company on July 21, 1986. The final design is based on CSDP Process Criteria Development for the Central Training Facility, Task C-9, Final Report, May 1987. This design criteria package incorporates comments of the Program Executive Officer-Program Manager for Chemical Demilitarization (PEO-PM Cml Demil) and the U.S. Army Corps of Engineers, Huntsville Division (CEHND), which were received at the review meeting on April 23, 1987.

1.2.2 SCOPE

The training program covers personnel safety, agent-release prevention, decontamination procedures, hazardous operations, emergency response and contingency plan implementation, and training documentation, as well as normal process and facility operations and maintenance (O&M). The training program consists of initial classroom training, hands-on training using the equipment, and continuation training and refresher courses. The program will ensure that all CSDP facilities are operated in a uniform and consistent manner that provides protection to human health and the environment both on and off the facility site and that minimizes the factors degrading human performance or increasing the likelihood of human error. Final training will be performed in the actual demilitarization plants during systemization and preoperations.

The major pieces of equipment to be provided in the CTF are given in Table 1-1, which lists all major process and process-related equipment. This table gives a comprehensive identification of equipment locations and equipment

[1]Appendix A lists the acronyms and abbreviations used in this document.

Table l-l - Major Process Equipment to be Provided at the CTF

Equipment	CTF Room	Equipment Type for CTF
Control Room (CON) Simulation		
Demilitarization console	CON	A[a]
Furnace console	CON	A[a]
Engineering/maintenance console	CON	A[a]
Demilitarization protective ensemble (DPE) console	CON	A[a]
Trainer's console	CON	A[a]
Supervisor's console	CON	A[a]
Status board	CON	A[a]
Process data acquisition and recording (PDAR) unit and central processing unit (CPU)	Computer room	A[a]
Programmable logic controller (PLC) network manager	CON, DER	A[a]
Simulator computer and peripherals	Computer room	A[a]
Closed-circuit television (CCTV) system	CON	A
Demilitarization Equipment		
Rocket shear machine (RSM)/burster size reduction (BSR) machine kit	DER	A
Mine machine (MIN)	DER	A
Projectile/mortar disassembly (PMD) machine	DER	A
Multipurpose demilitarization machine (MDM)	DER	A
Bulk drain station (BDS)	DER	A
Furnaces		
Liquid (LIC)-type burner assembly/feed system	Burner Area	SD
LIC	Furnace	SM
Primary chamber		
Secondary chamber		
Burner assembly		
Combustion air blowers		
Agent feed assembly		
Decon feed assembly		
Purge brine pump		
Interconnecting piping and ductwork		
Manual control stations		

[a]CTF software will provide simulation of actual plant operating scenarios.

Table 1-1 (Contd)

Equipment	CTF Room	Equipment Type for CTF
Furnaces (Contd)		
Deactivation furnace system (DFS)	Furnace	SM
Retort assembly		
Blast attentuation duct		
Cyclone		
Afterburner		
Feed chutes and blast gates		
Discharge chute and blast gates		
Heated discharge chute and blast gates		
Combustion air blowers		
Interconnecting piping and ductwork		
Manual control stations		
Metal parts furnace (MPF)	Furnace	SM
Furnace chamber		
Charge airlock		
Discharge airlock		
Conveyor system		
Afterburner		
Combustion air blower		
Ductwork and interconnecting piping		
Manual control stations		
Dunnage incinerator (DUN)	Furnace	SM
Dunnage elevator		
Ram feed		
Primary chamber		
Afterburner		
Combustion air blower		
Interconnecting piping and ductwork		
Manual control stations		
Liquid Petroleum Gas (LPG) Storage Tank	Outside building	SD
Plant and Instrument Air Compressors	DER	SD
Pollution Abatement System (PAS)		
WET PAS	PAS	SM
Quench tower		
Venturi scrubber		
Scrubber tower		
Demister vessel		
Demister wash system		
Stack		

Table 1-1 (Contd)

Equipment	CTF Room	Equipment Type for CTF
PAS (Contd)		
DUN PAS (Contd)	PAS	SM
Quench tower		
Baghouse		
Stack		
Material-Handling Equipment (MHE)		
Inert munitions	Varies	S
Munitions forklift	UPA	A
Bridge crane ('j-ton)	one: common to UPA, DER	A
Jib crane (3-ton)	UPA	A
Monorail hoist (3-ton)	TMA	A
Rocket metering input assembly	UPA	A
Projectile metering input assembly	UPA	A
Roller conveyor	UPA	SD
Electric		
Hydraulic, indexing	DER	SD
Tilting conveyor	DER	SD
Blast gate	DER	A
Multiposition loader (MPL)/pick-and-place (P&P) machine	DER	A
Munition tray assemblies	UPA, DER	A
Agent-removal verification system for RSM and MIN	DER	A
Process/fire gate	DER	A
DFS feed chute and blast gates	DER	M
Hydraulic power unit	DER	A
Hydraulic valve manifold	DER	A
DPE Support Area (DSA) Equipment		
Heat sealer with chiller	DSA	A
Helium leak detector	DSA	A
Radio	DSA	A
Hose racks	DSA	A

Table l-l (Contd)

Equipment	CTF Room	Equipment Type for CTF
Simulated Airlock	DSA	S
Protective Clothing		
DPE suits and accessories	Varies	A,M
M3 equipment (suits, aprons, masks)	Varies	A
Life Support System (LSS)		
Air hoses	Varies	
LSS air compressor	DSA	
Emergency air supply bottles	Varies	
Bottle filling air compressor and receiver	DSA	
Heating, Ventilating, and Air Conditioning (HVAC) Filter Unit		
High-efficiency particulate air (HEPA)	DER	
Charcoal filter unit	DER	
Monitoring Equipment		
Automatic continuous agent monitoring system (ACAMS)	OBV	A
Bubbler system	OBV	A
DAAMS, etc.	OBV	
Test and Calibration Equipment	Various	A

modifications for use in training. The following designators explain how each piece of equipment will be represented physically:

Designator	Equipment	Description
A	Actual	Identical manufacture to those to be furnished
SD	Scaled down	Similar manufacture to actual equipment but on 8 reduced scale
S	Simulation	Identical manufacture to actual equipment but modified to only simulate actual operations
M	Mockup	Model with necessary function81 components required for training
SM	Scale model	Nonoperational replica

1.3 CRITERIA

Criteria are provided in Task C-9, Process Equipment Descriptions for Central Training Facility, May 22, 1987.

1.4 PROJECT DESCRIPTION

1.4.1 CONSTRUCTION SITE

The construction site is at AFG, Edgewood, Maryland, bounded by Douglas Road on the north, Second Street on the east, Parrish Road on the south, and Gannon Street on the west.

1.4.2 FUNCTION

The basic functional objective of the CTF is to provide both initial and continuing training of all supervisors, operators, maintenance personnel, and laboratory personnel involved in the CSDP. The CTF will include actual equipment, simulation equipment, or models for training. Because this equipment will not be exposed to any agents, it can be also used for troubleshooting actual operational problems.

1.4.3 PERSONNEL AND EQUIPMENT

The facility is designed to house students and staff members up to 560 people on 2 shifts.

1.4.4 CONSTRUCTIBILITY

The Government-furnished equipment (GFE) includes, but is not limited to, specially designed and manufactured equipment, long-lead items, LIC burner assembly, and process control equipment. The specialized equipment and long-lead items will be procured by a special procurement contractor, i.e., the equipment acquisition contractor (EAC). The equipment listed above will be provided to the systems contractor (SC) for construction, equipment installation, systemization, operations, and closure. The SC also furnishes and installs all non-Government-furnished process equipment including process control simulation system (PCS'S) software and hardware.

Equipment common to the CTF and an actual demilitarization plant will be procured and installed to the quality assurance (QA) classification assigned to the equipment at an actual demilitarization plant.

1.4.5 ECONOMIC SUMMARY

Life-cycle costs and schedules for program options were previously submitted as a contract deliverable (Chemical Stockpile Disposal Plan Supplement, Report AMCPM-CD-FR-87109, dated March 1987). The life-cycle costs are based on the most recent JACADS and cryofracture/thermal destruction cost data. The CSDP Supplement provided summary life-cycle costs and schedules for the baseline CSDP and for each onsite alternative.

2.2 PROCESS

2.2.1 LIQUID BURNER SYSTEM

A. Process Description

The primary function of the LIC burner system is to provide maintenance and operational training on the burner train and instrumentation.

Ethylene glycol and/or fuel gas will be combusted with air in the burner. Fuel gas will be used to initially heat up to operating temperature and will also be provided to ensure that simulant incineration continues. Excess air will be added to maintain the exhaust gas temperature at 2,000°F.

Cases from the burner combustion chamber will be exhausted to a gas quencher followed by an induced draft blower and an exhaust stack. No PAS is required at CTF because the ingredients of the fuels combusted are carbon, hydrogen and oxygen [ethylene glycol ($C_2H_6O_2$)], and fuel gas or propane (C_3H_8). Draft in the chamber will be maintained at approximately minus 1.0 in. water column. The gas quencher will be a venturi-type water injection cooler and will quench the exhaust gas to a nominal 300°F.

B. Design Description

The LIC shall be a burner system incinerator designed to incinerate approximately 4 million Btu/hr of ethylene glycol (8,245 Btu/lb HHV) and/or fuel gas (21,670 Btu/lb HHV). The burner to be used shall be an LV-type vortex burner similar to the vortex burner used at the Chemical Agent Munitions Disposal System (CAMDS) in the reduced size LIC installed there and similar to the LV-14 vortex burner installed in the LIC at the Johnston Atoll Chemical Agent Disposal System (JACADS).

The primary burner chamber shall be a refractory-lined unit with an inner cylindrical chamber to provide a nominal 120 ft^3 of volume for combustion gases. The refractory lining shall be designed to allow not more than 80,000 Btu/hr heat loss to the surrounding area. The furnace shall operate under negative pressure at all times.

The exhaust gas quencher shall be a venturi-type water-injection quench unit capable of quenching to 300°F, an exhaust gas of approximately 7,000 acfm at 2,000°F and with a molecular weight of 28.4, and a nominal specific heat of 0.286 Btu/lb.

The exhaust stack shall be sized for a maximum exhaust velocity of 67 ft/sec at 300°F and shall be 50 ft in height.

2.3 MECHANICAL PROCESS

2.3.1 GENERAL PARAMETERS

A. Scope and Purpose

The mechanical process functions provide a detailed development of the systems presented in the process flow diagrams (PFDs) with definitions given of sizes, capacities, design pressures, and materials of construction for all equipment and piping required for the process. Piping and instrumentation diagrams (P&IDs) describe the functional relationship of the equipment with the various monitoring and control devices required for systems operation.

The systems discussed in this subsection cover piping and equipment for simulated agent collection and munitions filling. The process system for the LIC furnace is described in subsection 2.2.1. Demilitarization machines and material handling systems associated with these machines are described in subsection 2.6.

B. Types of Equipment

Simulated agent collection equipment consists of a tank, pumps, duplex strainer, valves, controls, and all interconnecting piping.

C. Design Guidance

Unless stated otherwise, this system is in accordance with the criteria and design requirements provided in the report, Process Equipment Descriptions for Central Training Facility, May 1987.

2.3.2 FUNCTIONAL AND TECHNICAL REQUIREMENTS

A. Simulated Agent Collection System (AC'S)

1. System Description. The simulated ACS is designed to collect, store, and pump simulated agent (ethylene glycol) to the LIC furnace for disposal. Simulated agent is collected from the MIN, RSM, BDS, and MDM machines. Simulated agent is pumped from the RSM via a weigh station by air-operated diaphragm transfer pumps to the agent holding tank. Simulated agent is pumped to the agent holding tank by separate collection headers from each piece of demil equipment.

The simulated agent is pumped from the holding tank to the primary combustion chamber of the LIC for disposal. If the LIC system is down, excess simulated agent collected from the munition processing stations is pumped to the glycol storage tank (see Section 2.9.3.B.8) for reuse.

2. Equipment.

a. Agent Transfer Pumps. The five agent transfer pumps are air-operated diaphragm pumps sized for 15 gal/min. This type of pump permits adjustment of the pump rate depending on the throughput rate of the munition that is being processed.

b. Agent Holding Tank (500 gal working capacity). The size of the 500-gal agent holding tank minimizes the quantity of simulated agent to be stored in accordance with the results from the M55 safety studies. This is a standard size tank for all CSDP sites.

c. Agent Feed Pump. The agent feed pump is a magnetically coupled, seal-less gear pump sized for 2.9 gal/min. This type of pump was selected because of the small flow rate and high head requirements. The seal-less design prevents simulated agent leakage to the outside and requires low maintenance.

d. Agent Collection Headers. Maximum flow rates for draining operations are based on the processing rates for various munitions and the amount of processing time estimated for draining operations. Four agent collection headers to the holding tank are used, one from each munition draining system.

B. Munitions Filling System

1. System Description. The munitions filling system is designed to refill the munitions (projectiles and mortars) with simulated agent (glycol) for recycling. Note that M-55 rockets, M23 land mines, and ton containers will be destroyed (or severly damaged) during processing operations, therefore making them unfit for reuse.

After the completion of draining and processing, munitions are placed in storage to await refilling. The munitions are moved from storage to the refill area where they are filled with glycol using a batch flowmeter. After filling, the munition is sealed with a burster well inserted by a hydraulic press. They are then removed to storage to be reused.

2. Equipment.

a. Hydraulic Press. The hydraulic press is a double-acting press with 50-ton capacity and electric power pump.

b. Batch Flowmeter. A batch flowmeter that may be preset to the quantity desired and activated manually is used for filling.

2.4 PIPING

2.4.1 GENERAL PARAMETERS

A. Scope

Piping systems are provided within the CTF. The systems include primary cooling medium and hydraulic systems for the demilitarization equipment and for all liquid furnace piping and piping systems for simulated agent, simulated decon, spent decon, and utility piping.

Piping design includes material selection, component classification, provision of specialty items, run locations, preliminary stress analysis procedures, installation, and testing procedures. Pipe supports, except as indicated on the structural drawings, are designed and supplied by the systems contractor.

B. Design Considerations

Piping located out of doors, exposed to weather, and subject to freezing is heat-traced to prevent freezing. Elevated steel structures are used to support aboveground piping between the building and the unloading area. Preliminary stress analysis is provided for high-temperature piping only (furnace ducts, piping 300°F and above). Final stress analysis is provided by the SC. Furnace high-temperature-duct stress calculations are performed by the vendor of the equipment or by the system designer. Specialty piping that is furnished by a vendor, such as hydraulic or burner piping, is shown schematically until vendor information is provided.

Generally, service piping within the building follows the corridors. At points along the routing, the piping is branched, where required, and penetrates the walls.

2.4.2 FUNCTIONAL AND TECHNICAL REQUIREMENTS

A. CTF Building

Process piping within the confines of the CTF building relates primarily to the fuel supply and burner'controls at the LIC furnace. The furnace vendor supplies the critical valves and piping required for operation of its burners.

B. TOXIC CUBICLE (TOX)(ACS)

Simulated agent (glycol) is fed either from munition draining or from the glycol storage tank located in the yard to the agent-holding tank located within the CTF building's DER. The simulated agent is then pumped to the LIC burner system for incineration. The SC routes the piping from the agent-holding tank to a point near the LIC burner and connects to the vendor piping.

2.5 MECHANICAL FILTER SYSTEM DESIGN

2.5.1 GENERAL PARAMETERS

An operational charcoal exhaust filtration unit is provided for training the plant operating personnel in the changeout of the charcoal and HEPA filter cells. The training unit is to be complete with all controls, blower, motor drives, piping, and stainless steel housing. Loading equipment is supplied with the training unit to give the trainees experience with using the maintenance tools and the charcoal filter. With this filter unit, the trainees can learn to change out the filter cells while wearing a DPE suit.

The basic design data follows:

(1) Location

(a) APG, Aberdeen, Maryland
(b) Latitude: 39°28'
(c) Longitude: 76°10'
(d) Elevation: 10 ft above sea level

(2) Wind

(a) Average velocity: 6.8 mph
(b) Direction: WNW

(3) Outdoor design temperatures

(a) Summer (dry bulb): 94°F
(b) Summer (wet bulb): 77°F
(c) Winter (dry bulb): 11°F

2.5.2 EXHAUST FILTER SIMULATION

The exhaust filter supplied for the CTF will be the same as used at the actual destruction sites, 16,000 cfm with blower. The filter unit will be operational and use actual filter cells for training. Because the actual ventilation system operation for a demilitarization plant is simulated on the computer, the filter unit controls will be modified for local operation only (see the drawings for the sequence of operation).

2.6 MATERIAL HANDLING AND DEMILITARIZATION EQUIPMENT

2.6.1 GENERAL PARAMETERS

A. Scope and Purpose

The material handling systems for the CTF process training systems consist of material conveying systems, hydraulic systems, special mechanisms, and blast gates for the UPA and demilitarization room, as well as all demilitarization equipment. Cranes and monorail systems are described in the Facilities Design Analysis.

B. Deviations from JACADS Design

The material handling flow and equipment for the CTF process training systems are patterned on the TEAD flow and equipment.

C. Special Considerations

In accordance with the process criteria, each piece of equipment in the material handling system has a design operating rate of 1.25 times the naainal peak operating rates. Therefore, the systems are capable of operating above nominal capacities for sustained periods.

Special consideration is given in the equipment selection and design, including rounded corners, continuous welds, weepholes, 42-in. clearance around equipment, and quick-disconnect components for maintenance by personnel suited in DPEs. The special considerations are dictated by the limited time that personnel can function in DPEs, limitations on movement, impaired manual dexterity, limited bending and reach capabilities, inability to perform welding or cutting operations, and travel restraints caused by the maximum length of the air supply hoses.

To reduce spare parts inventory and simplify maintenance, the number of different types of conveyors and other equipment is kept to a minimum. The number of conveyor supports is minimized to allow for ease in cleanup and access around the conveyors. Equipment and conveyors have single pedestal supports, wherever possible. All conveyors are reversible to allow clearing in case of equipment breakdown. A crane is located above all conveyors and demilitarization equipment to assist in maintenance of equipment during malfunction and during initial installation and campaign changeover. Equipment and components are accessible from at least two directions.

Equipment is designed to be installed in modular sections after construction of the building. Design provides for ease of removal of equipment. Sensing and control components of all material handling and demilitarization equipment interface with the local and remote control systems. Equipment designs comply and are in accordance with the applicable standards and codes as described in the CTF CSDP Process Development for the CTF, May 1987.

2.6.2 FUNCTIONAL AND TECHNICAL REQUIREMENTS

The demilitarization machines and material handling equipment are located within the Main Building and consist of material moving systems, demilitarization equipment, special mechanisms, blast gates, overhead crane and hoisting equipment, maintenance and repair equipment, and mobile equipment, as well as miscellaneous Items, DPE suit sealers, storage lockers, etc. All major items are described below.

2.6.3 ROCKET SHEAR MACHINE (RSM)

The main components of the RSM consist of:

(1) Rocket drain station
(2) Rocket shear station
(3) Rocket fuze buffer conveyor
(4) Agent verification and measuring system

The RSM performs five basic functions:

(1) Orients and aligns rocket for operations
(2) Punches and drains agent from rocket
(3) Measures agent drained from rocket
(4) Shears rocket into five pieces to feed into deactivation furnace
(5) Segregates first cut of each rocket (fuze section) from next four sections

The RSM is an automatic, hydraulically powered machine that receives a simulant-filled rocket within its fiberglass tube and then transfers it into the rocket punch-and-drain station. At the punch-and-drain station, the rocket is secured to the machine base by clamps; two holes are punched into the front and rear surfaces of the agent cavity at the rocket bottom and one hole is punched at the top of the rocket to serve as a vent hole. After at least 95% of the simulant liquid is removed, the clamps are released and the rocket is raised and rotated 90 degrees to prevent simulant residue dripping while the rocket is being transferred to the next station. After completing the punch-and-drain operation, the rocket is transferred to the rocket shear station, the munition access blast gate is opened, and the stop is lowered to allow the next rocket into the explosive containment room (ECR).

If the rocket is misoriented, the punches at the punch-and-drain station cannot penetrate the rocket motor cavity, whereupon an alarm sounds in the CON, operations stop, and personnel enter the area to correct the problem.

At the rocket shear station, the rocket is advanced to the first cut position, where the shear blade makes the cut immediately behind the rocket fuze to remove the explosive-initiating components from the remaining explosives. The fuze is collected by the rocket fuze buffer conveyor. After collecting the rocket fuze, the rocket fuze buffer conveyor retracts away from the shear blade. The rocket then advances and the next three sequential cuts are made to divide the rocket body into four pieces. A continuous water spray is provided to cool the shear blade after each cut.

When the fuze buffer storage conveyor in the ECR is filled with 12 fuzes, the RSM shearing operations is stopped. The fuzes are then fed into a container, simulating the dumping of the fuzes into the DFS chute.

2.6.4 MINE MACHINE (MIN)

The main components of the MIN consist of:

(1) Mine orientation station
(2) Mine punch-and-drain station
(3) Burster punch station
(4) Agent verification and measuring system

The MIN performs four basic functions:

(1) Orients and aligns the mines for operations
(2) Punches and drains the agent from the mines
(3) Measures the agent drained from the mines
(4) Separates the mine booster from the mines

The MIN is an automatic, hydraulically powered demilitarization machine, located in the ECR, that is designed to process M23 land mines. The MIN receives a mine from the mine feed conveyor and transfers it to the mine orientation station, where it is placed into a yoke. The yoke lifts the mine before it is rotated; the mine is then rotated counterclockwise. When the mine is correctly oriented, a sensor indicates proper orientation. The yoke rotates the mine to the vertical punch position, and a sensor signals when the yoke is in the vertical position against the yoke stop. The mine is then clamped, the yoke stop is retracted, and the hollow drain punches are inserted into the body of the mine. To minimize splashing, the agent diaphragm pumps are turned on to start draining simulant through the hollow punches as soon as the punch enters the mine. A removal of more than 95% of the simulant is required. After the simulant is drained, the simulant is transferred to the agent verification and measuring system, which is identical to the RSM agent verification and measuring system described in subsection 2.6.3.

After completing the mine draining operations, the drain punches are retracted, the mine is unclamped, and the mine is then rotated by the yoke to the trolley station. The mine is now resting on the trolley in an inverted position; the agent pump is turned off. The mine is transferred by the trolley to the burster punch station. At the burster station, a sensor detects that the mine is present at the punch station and ready for the burster to be punched. A signal is then sent, allowing the yoke to return to home in order to start a new mine to be processed. The yoke stop is extended at this time.

At the burster punch station, the burster is punched and the booster is removed. The burster punch remains down to hold the mine in this position while the trolley is removed from beneath the mine. The booster charge has meanwhile been dropped onto a container. After the booster charge has been discharged, the trolley moves back toward its initial position and stops in the middle of the track. At that time, the burster punch retracts, releasing the mine. The trolley then moves forward and pushes the mine onto a container. At the MIH, the trolley returns to the initial position and is ready to process the next mine.

2.6.5 PROJECTILE MORTAR DISASSEMBLY (PMD) MACHINE

The main components of the PMD machine consist of:

(1) Infeed transfer station (Station 1)
(2) Nose-closure removal station (Station 2)
(3) Miscellaneous parts removal station (Station 3)
(4) Burster removal station (Station 4)
(5) Mscharge/output station (Station 5)
(6) Nose plugs, fuzes, and miscellaneous parts conveyor
(7) Burster-removal conveyor
(8) 300-psi air compressor

The PMD performs six basic functions:

(1) Removes nose plugs or nose fuzes from projectiles and mortars

(2) Punches booster charge when there is a booster attached to fuze

(3) Removes fuze cups, miscellaneous parts, and/or supplementary charges from projectiles

(4) Removes burster charge from projectiles and mortars

(5) Feeds bursters to BSR machine for shearing

The PMD is an automatic, hydraulically powered machine installed in the ECR to process all calibers of projectiles and mortar munitions in order to remove their explosive components. The PMD is an eight-position, rotating-table machine with five main stations remotely controlled by a PLC.

A. Station 1: Infeed Transfer Station

The PMD sequence of operation for all munitions except 8-in. projectiles follows:

(1) ECR munition access blast gate opens, and a projectile is allowed into ECR.

(2) Projectile travels on projectile feed conveyor to PMD transfer Station 1.

(3) Projectile is transferred from feed conveyor to load station saddle by the transfer conveyor pusher.

(4) Transfer conveyor pusher reverses and returns halfway to home on top of the PMD.

(5) Index table rotates projectile to nose closure removal Station 2.

(6) Pusher conveyor moves forward and returns to home.

Steps 1 through 5 are repeated for the next three projectiles. Before the table is rotated, however, additional input is provided from Stations 2, 3, and 4 to indicate that processing is complete.

(7) Index table rotates projectile to unload station.

(8) Projectile is transferred from the unload station saddle to the output conveyor by the pusher. The pusher continues around to home, and the next projectile is placed onto the infeed conveyor. When the pusher returns to home, steps 1 through 5 are repeated, followed by steps 6 and 7, until the last projectile is placed onto the indexing table. Then steps 7 and 8 are repeated until all projectiles are removed from the indexing table.

The sequence for processing 8-in. projectiles is essentially the same, except that only one projectile is processed at a time.

B. Station 2: Nose Closure Removal Station

The sequence of operations for processing 105-mm, 155-mm, and 8-in. projectiles follows:

(1) When a projectile is at work Station 2, a sensor at that station indicates that a projectile is at the station and that work can begin.

(2) Projectile is clamped.

(3) Nose closure removal carriage moves to the forward position.

(4) Hydraulic chuck engages the projectile nose closure.

(5) Hydraulic chuck unscrews the nose closure; a sensor counts revolutions of the hydraulic chuck (14 revolutions for 105-mm and 155-mm projectiles, 14 revolutions for 4.2-in. mortars, and 12 revolutions for 8-in. projectiles).

(6) Nose closure removal carriage retracts to the booster punch position and/or nose closure release position.

(7) Projectile is unclamped; steps 6 and 7 commence simultaneously.

(8) Gripper slide is lowered.

(9) Gripper punches the booster cup.

(10) Gripper punch is retracted.

(11) Gripper slide is raised.

(12) Nose closure removal chuck releases the nose closure onto the conveyor.

(13) Nose closure removal carriage returns to home position.

An exception to the above sequence of operations occurs when processing 155-mm and 8-in. projectiles, for which steps 8, 9, 10, and 11 are not required.

The sequence of operations when processing 4.2-in. mortars follows:

- o Steps 1 through 5 remain the same as above.

(6) Nose closure removal carriage retracts to burster unscrew position.

(7) Mortar is unclamped; steps 6 and 7 commence simultaneously.

(8) Gripper slide is lowered.

(9) Mortar burster is gripped.

(10) Nose closure removal chuck unscrews fuze from burster (a sensor will count 16 revolutions of the chuck).

(11) Burster is released onto conveyor.

(12) Gripper slide is raised.

(13) Nose closure chuck releases mortar fuze onto conveyor; steps 1 and 13 commence simultaneously.

(14) Nose closure removal carriage returns to home position. A sensor will signal to indicate work is completed at this station.

C. <u>Station 3: Miscellaneous Parts Removal Station</u>

The sequence of operations in processing 105-mm (M60) and 155-mm (M110) projectiles follows [this station is not required for processing 4.2-in. mortars and 105-mm (M360) and 155-mm (M121) projectiles] :

(1) When a projectile is at Station 3, a sensor signals a projectile's presence at the station, and work can begin.

(2) Projectile-positioning cylinder extends.

(3) Projectile-holding cylinder extends.

(4) Miscellaneous parts removal carriage moves forward, inserting collet into fuze cup.

(5) Collet-release cylinder retracts, and collet engages fuze cup.

(6) Fuze cup removal hydraulic motor begins unscrewing fuze cup (counterclockwise rotation).

(7) After fuze cup is unscrewed, miscellaneous parts removal carriage moves to FUZE CUP UNSCREWED position.

(8) Miscellaneous parts removal carriage moves to midposition and/or SPINDLE RESET POSITION, removing collet with cup from projectile.

(9) Collet-release cylinder extends, releasing collet.

(10) Miscellaneous parts removal carriage moves to BEGIN SPINDLE RESET position, stripping fuze cup from collet.

(11) Projectile-holding cylinder retracts.

(12) Projectile-positioning cylinder retracts.

(13) Fuze cup removal hydraulic motor begins spindle reset.

(14) Spindle reset moves miscellaneous parts removal carriage to midposition and/or SPINDLE RESET POSITION. A sensor signals that work is complete at this station.

The sequence of operations for processing 155-mm (M121A1) projectiles follows:

o Steps 1 and 2 remain the same as above.

(3) Miscellaneous parts removal carriage moves forward, and magnet contacts supplementary charge cup.

(4) Miscellaneous parts removal carriage cylinder extends fully, stripping charge cup from magnet.

(5) Projectile-positioning cylinder retracts.

(6) Miscellaneous parts removal carriage returns to midposition; a sensor signals that work is complete at this station.

The sequence of operations for processing 8-in. projectiles follows:

o Steps 1 and 2 remain the same as above.

(3) Miscellaneous parts removal carriage moves forward, and supplementary charge gripper is inserted into projectile mouth.

(4) Gripper jaws close on supplementary charge (this cylinder has a spring-return feature for extended position - jaws open).

(5) Miscellaneous parts removal carriage moves to midposition with supplementary charge.

(6) Gripper jaws open, dropping supplementary charge onto conveyor.

(7) Projectile-positioning cylinder retracts. A sensor signals that work is complete at this station.

D. Station 4: Burster Removal Station

The sequence of operations for processing all projectiles follows. This station is not required for processing 4.2-in. mortars.

(1) Projectile is at Station 4. A sensor signals that a projectile is present and work can begin.

(2) Projectile-positioning cylinder extends.

(3) Burster removal station carriage moves forward and delta P head contacts projectile.

(4) Delta P cylinder rod extends, contacting burster.

(5) Air pressure (100 psi) is applied to delta P head.

(6) Delta P cylinder rod retracts, carrying burster.

(7) Solenoid valve exhausts to atmosphere, thereby removing air pressure from delta P head.

(8) Delta P cylinder rod retracts without burster and collet is closed. A sensor indicates whether burster was gripped by collet and removed from projectile. If burster was not removed, two more attempts are made, using 300-psi air, and Steps 4 to 8 are repeated. Projectile is designated a problem item after three failed attempts and is rejected to the projectile reject table located in the ECR vertibule (ECV).

(9) Burster removal station carriage retracts to midposition with burster.

(10) Burster conveyor is lowered.

(11) Burster conveyor gripper grasps burster.

(12) Delta P cylinder rod extends to COLLET RELEASE position.

(13) Burster removal station carriage returns to home position.

(14) Burster conveyor is raised.

(15) Burster is transported to BSR feed chute.

(16) Gripper releases burster onto BSR chute.

(17) Burster conveyor returns home. A sensor signals that work is complete at this station.

E. Station 5: Discharge/Output Station

The sequence of operations for this station is essentially the same as that for infeed transfer Station 1, except that the projectile is discharged from the PMD table onto the projectile-discharge conveyor. Exceptions to the above PMD sequence of operations follows:

(1) Complete processing of mortars is accomplished at Station 2. Input from Stations 3 and 4 is not required.

(2) Complete processing of 105-mm (M360) and 155-mm (M121) projectiles is accomplished at Stations 2 and 4. Input from Station 3 is not required.

(3) If Station 2, 3, or 4 fails to complete the processing of a projectile in accordance with its respective sequence of operations, that projectile is designated a problem projectile. The projectile remains on the table until it is returned to the load station, where it is taken off the table by running the pusher and infeed conveyor in reverse.

2.6.6 BULK DRAIN STATION

One full-size BDS will be installed at the CTF to simulate actual demilitarization operations for O&M training purposes. The following BDS description shows the full spectrum of the BDS capabilities, although at CTF only simulant-filled ton containers will be processed for training purposes.

The main components of the BDS consist of:

(1) Station anvil and punch frame
(2) Hydraulic indexing roller conveyor
(3) Hydraulic punch cylinders
(4) Drain station with Teflon-coated diaphragm pump
(5) Indexing conveyor extend/retract cylinders with load cells

The function of the BDS is to punch and drain the chemical agents from all bulk munitions, such as the ton containers. The BDS is a remotely controlled, hydraulically powered machine. The sequence of operation follows:

(1) A munition tray carrying pairs of the above MC-l or MK-94 bombs or a single M116 bomb, spray tank, or ton container is delivered by the charge car to the BDS input feed conveyor.

(2) The tray is discharged from the charge car onto the input feed conveyor at a speed of 40 ft/min.

(3) The tray is fed from the input feed conveyor onto the BDS indexing conveyor.

2.7 ELECTRICAL AND COMMUNICATIONS

2.7.1 GENERAL PARAMETERS

Power is provided to all process loads.

The equipment lighting will provide sufficient illumination for safety and working conditions. White flashing lights, indicating telephone calls in the mechanical equipment room (MER) and in high noise areas, are controlled by the telephone-ringing circuit. PVC conduit is not used.

Communications support consists of process CCTV and DPE radio systems.

2.7.2 FUNCTIONAL AND TECHNICAL REQUIREMENTS

Electrical power loads, load factors, and allowances for future loads are listed in the load summary sheets as part of the calculations.

Power is provided at the following voltages derived by successive transformation from 480 volts, three-phase; 208 volts, three-phase; 120 volts, single-phase.

A system based on process communication requirements is provided for rapidly establishing a communications link between the control room and maintenance personnel in order to observe and communicate with personnel within the process areas.

2.7.3 DESIGN OBJECTIVES AND PROVISIONS

A. Power Distribution System

Normal power for the process system originates at the load side of facility construction package (FCP)-supplied 480-volt switchgear. All 480-volt system loads are fed from the FCP-supplied 480-volt switchgear and motor control centers (MCCs).

B. 480-Volt Power Distribution

The 480-volt switchgear power distribution is accomplished by locating the MCCs or panelboard near the loads, thereby minimizing long runs and voltage drops. The feeders to MCCs, power panels, or transformers originate at the load side of the circuit breakers at the 480-volt switchgear and are routed in conduits. In outdoor areas, the above ground feeders are placed in rigid steel conduits.

C. Instrument Grounding System

A separate grounding system, which will be connected to the main ground grid in only one place, will be installed for low signal level controls in the central control room. This will minimize noises picked up from the main grounding system and prevent large ground currents from circulating in the control grounds. The shields or drain wires for instrument signals will be grounded only at the control room. A separate ground wire inside rigid steel conduit will not be required.

D. MCCs

The MCCs are metal enclosures housing disconnects, starters, and control transformers. In addition, MCCs contain terminals, relays, primary and secondary busing, ground bus, fuses, and all necessary control wiring to provide motor control. MCCs are rated at 480 volts, three-phase, three-wire plus ground bus, 60 Hz, dead front, suitable for indoor installation and consisting of one or more vertical sections bolted together to form a rigid, free-standing assembly. The MCCs provide power and control to all three-phase, 460-volt motors and all other equipment requiring 480-volt, three-phase power. The MCCs are placed in proximity to large loads as shown in the electrical power plans.

E. Special Systems

The communication systems consist of process CCTV and DPE radio systems.

1. Process CCTV. The process CCTV system allows the CON operator to view the process areas in detail. The system uses cost effective Vidicon sensors for normal light application. The video signals are routed via video switches to various monitors. Each monitor has full control over the camera whose video signal is routed to that monitor. Video cassette recorders (VCRs) are included in the system to record the process event for later viewing. The cameras are equipped with pan-tilt-zoom focus features.

2. DPE Radio. The DPE radio is to be used for communication between the control room operator and DPE suit wearers in the main building. There will be one fixed base station with three transmitter-receivers and one portable base station. This allows a total of three DPE-wearer teams for training purpose.

The system is designed using the following guidelines:

(1) The system is mainly a very specialized system that can be analyzed and designed mainly by the manufacturer, e.g., communications-applied technology.

(2) After contract award, the manufacturer will perform and submit the following analysis for review, comment, and approval:

(a) Signal level analysis
(b) Signal-to-noise ratio (S/N) analysis
(c) Antenna location analysis
(d) DPE radio and PABX interface

(3) The antenna locations will be field verified for optimum reception.

(4) The antenna cables are installed in conduits.

2.8 CTF CON SIMULATION

Control system components located in the CTF will permit training of O&M personnel in all aspects of plant O&M. Training for operations of demilitarization machines will be performed by actual operation of the machines using simulated munitions, both in the automatic mode from the CON and in the manual mode from a local panel. Automatic and manual control of other process equipment not connected to the CTF central control system will be simulated using a simulation computer and trainer's console.

Canponents of the CTF control system and their relationships are shown in block diagram form in Figure 2.8-1. An overview of the CTF process control philosophy follows.

2.8.1 GENERAL CTF PROCESS CONTROL PHILOSOPHY

A centralized control system will be used at the CTF to provide remote automatic control and monitoring of all functional areas of the demilitarization equipment and of the CTF. CRT/keyboard-based control consoles will be located in a centralized CON for operator trainee interface with the CTF's functional area processes. Closed-circuit television (CCTV) monitors will be located on the status board and all control consoles. They will be used to monitor machine operations and DPE teams. A digital controller will contain all programs for controlling and monitoring the simulated processes. Programs will include startup, normal operation, normal shutdown, emergency shutdown, response to alarms, and interlocks. They will contain input and output modules for receiving input from field-mounted instruments such as pressure, flow, temperature and position transmitters, and switches, as well as providing output for control valve and motor operation. Data for graphic displays on the CRTs located on the control consoles will be transmitted from the digital controllers to the operator control consoles over a dedicated redundant data highway. Data will be displayed on the control consoles in graphic format arranged to provide rapid understanding by the operator trainees of the process status. The console keyboard allows the operator trainees to respond to data presented. Before processing a particular inert munition type, the required program is entered into the system at the engineering/maintenance console. Pendants, which are located in close proximity to the demilitarization machines (MDM, PMD, RSM, MIN), will be used by the trainer for demonstrating the operation of the machines.

Data required for report generation and sequence of event recording will be transmitted to the process data acquisition and recording (PDAR) system, which consists a central processing unit (CPU), programmers console, disk and tape storage, and printer. The PDAR will provide performance feedback where operator responses are recorded in the PDAR report and can be played back to identify and reconcile errors.

Local control of all material handling and demilitarization machines will be provided for maintenance training operations. A permissive interlock signal actuated through the central console's keyboard will be required before the selected equipment can be started locally. The equipment can be stopped at any time without a permissive interlock signal. Start and stop pushbuttons in

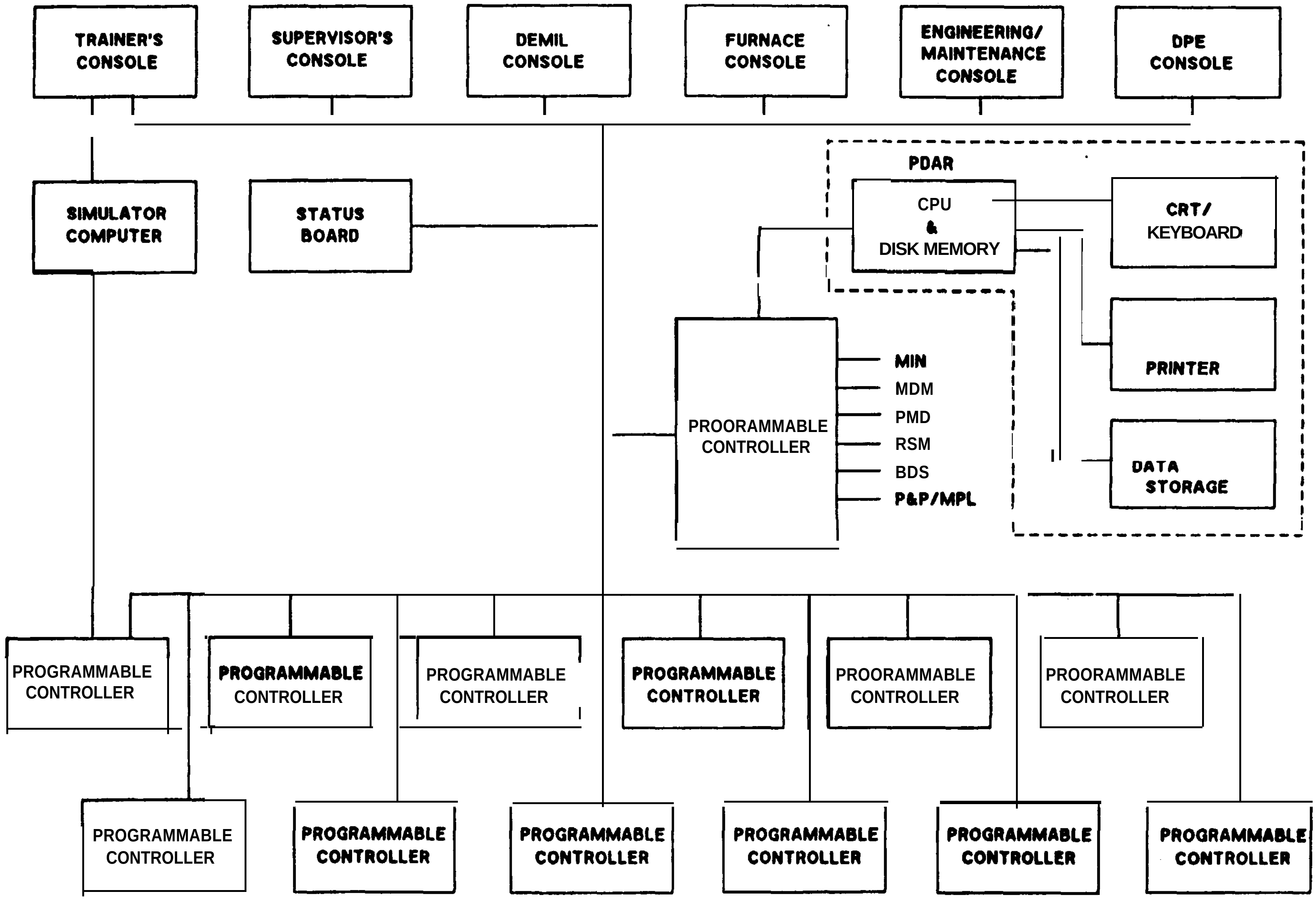

Figure 2.8-1 - CTF Control System Block Diagram

proximity to the pumps and motors will be provided for this function. Each demilitarization machine will have a panel mounted on its frame. This panel contains a local/remote switch and a pendant vith pushbuttons to allow actuation of machine canponents, i.e., extend/retract, raise/lover, start/stop, and jog. When the switch is in the local position, all commands from the automatic program in the CON will be locked out. When the switch is in the remote position, control from the pendant will be locked out. Maintenance personnel trainees, after placing the switch in the local position, must notify the CON of the component on the machine that is to be actuated. After the CON operator actuates the permissive signal, the maintenance personnel trainee actuates the component - at will - with the pushbuttons in the pendant.

2.8.2 CON CONSOLES

The following consoles, with the exception of the trainers console, will be installed in the demilitarization facilities. The number of demilitarization and furnace consoles required will depend on the type of munitions processed. Only one of each will be provided at the CTF. The presence of each type of console in the CTF will allow both training for the particular type of equipment (as designated by the type of console) as well as training of the CON personnel as a team. It will also allow training for correct response as individuals and as a team to simulated upset conditions.

Operator training for all operations in the demilitarization facilities can be accomplished by using the demilitarization and furnace consoles. Under extreme upsets, the supervising instructor can assume control of any system at the supervisor's console.

A. Demilitarization Console

The demilitarization console primarily controls and monitors the material-handling equipment associated with the feed of inert munitions into the process, conveying the inert munitions and operating the demilitarization machines. The capability will be provided to allow remote automatic operation of the RSM/BSR, MIN, PMD, MDM, BDS, and MPL/P&P machines as described in subsection 2.8. Provisions will be made to ensure that no control action will be performed by the central control system when local manual or automatic control is required during group training at the location of the demilitarization machines.

In the local training mode, all operations of the machine will be initiated from a local panel located close to the machine. Training for full operation of all material-handling equipment as actually installed in an operating plant will be accomplished through simulation programs in the simulation canputer. Simulation programs will provide training for both demilitarization console and lead operator's console operators.

B. Furnace Console

The furnace console will control and monitor all simulated operations of the LIC, DFS, MPF and DUN, and associated PASs. This includes all temperatures, flows, pressures, and measurements associated with the furnaces; munition components, dunnage, and agent feed to the furnaces; and movement of parts through the furnaces. In addition, temperatures, pressures, flows, pH, and density measurement simulations of the PASs will be monitored and controlled. The purpose of this console in the CTF will be to provide training for the operation of the furnaces and PASs and to monitor the interaction between the demilitarization equipment and the furnaces. Training will be accanplished through these simulation programs in the simulation computer.

C. Engineering/Maintenance Console

The engineering/maintenance console, located remote from the operators' consoles, will be used to train programmers and maintenance personnel in loading and modifying programs in the CTF control system and in isolating failed or malfunctioning equipment and providing guidance to technicians. In addition to the CRT/keyboard used to control and monitor the simulated processes, the engineering/maintenance console will contain a programming terminal for loading and modifying programs and for control system diagnostics.

D. DPE Console

The DPE console will be used for monitoring and supporting the training activities of personnel in demilitarization protective ensembles (DPEs) working in toxic training areas performing simulated maintenance operations or during the simulated processing of leakers. CTF process data will be displayed on a CRT in graphic format. CCTV monitors will allow the DPE teams to be monitored at all times. This console will be used to train personnel for interface between CON personnel and personnel wearing DPE suits.

E. Trainer's Console

The trainer's console will interface with the simulator computer. It will allow the development and modification of the process simulation programs. In addition, it will allow the trainer to monitor operator responses to normal operations while being trained and to observe operator trainer responses to upsets introduced into the system.

F. Supervisor's Console

The supervisor's console provides data that will allow the shift-supervising trainer to coordinate all the simulated process activities. In addition to having access to all data on process operations, this console will provide instructions for responding to contingencies. It will also be used to train shift supervisors in coordinating plant activities and in responding to contingencies and supervision of other CON personnel. This console will provide valuable team training to various operating scenarios.

2.8.3 STATUS BOARD

The status board will provide CON operator trainees with the simulated status of major process systems in graphic format at a single location. Systems will include process support, fire doors, fire detection alarms, explosion detection alarms, roan pressure/differential pressure alarms, and stack emission alarms. It is included in the CTF to provide training in all aspects of an actual plant CON.

2.8.4 PDAR AND CPU

The PDAR system u-ill include a CPU for operating programs, a CRT/keyboard for selecting report printouts and generating and modifying programs, a printer for reports, disk memory for operating data, and a tape deck for storing historical data. The PDAR system will provide report generation capabilities and all CTF process data for a prior period of operation. A printout of this data will allow an analysis to be made of simulated events leading up to an impact in the CTF process systems or shutdown. This will be used to train programmers and maintenance personnel by evaluating their responses to various scenarios.

2.8.5 PLC

The PLCs at the CTF will provide actual control of process training equipment. Field instruments and process equipment are wired to this controller. Operating programs are downloaded to this equipment from the engineering/maintenance consoles in the CON. Training will be conducted to support this operation. The demilitarization machines will be wired to the controller for automatic operation. Maintenance training will also be provided for this equipment.

Additional PLCs containing operating programs of an actual plant for use by the PCSS will be provided.

2.8.6 SIMULATOR COMPUTER

The simulator computer will be programmed to simulate the demilitarization processes. It will be interfaced with the centralized control system for training CON personnel. Various operating scenarios including normal startup, operations and shutdown, and emergency shutdown will be programmed into the system. The associated trainer's console will allow upsets to be simulated and operator responses to be observed. In addition, upsets and operator responses will be logged for consultation with the trainer.

2.8.7 CON LAYOUT

A CON layout will be developed for the CTF, which will house the equipment in a similar relationship to the demilitarization plant CON but will allow space for observation and instruction, as well as for simulation of all CON operations.

2.9 UTILITY SUPPLY AND DISTRIBUTION SYSTEMS

2.9.1 ARCHITECTURAL

See Facilities Design Analysis.

2.9.2 STRUCTURAL

A. Scope

The structural provisions for the CTF process system consists of structural supports for pipes, conduits and ducts, exhaust stack and foundations for pipe conduit and duct supports, stack, blower, instrument and LSS air receivers, air coolers, expansion tank, glycol tank, fuel oil tank, LPG tank, LPG vaporizer, charcoal and HEPA filter, power transformer, and pumps.

1. Loads.. The design is performed using the following loads:

(1) Dead Load: Weight of all supporting and enclosing materials and all equipment supported, including piping, ducts, and electrical conduits.

(2) Live Loads:

Floor = 100 lb/ft^2

(3) Snow Load: Ground snow load = 20 lb/ft^2 in accordance with ANSI A58.1-1982, exposure factor = 1.0, importance factor = 1.2.

(4) Test Load: Total of all vertical loads , plus the weight of test water in operating lines, tanks, and vessels.

(5) Friction and Thermal Load: The friction expansion force equals the coefficient of friction multiplied by the operating weight at the sliding support of a tank or vessel:

Surfaces	Coefficient of Friction
Steel to steel	0.40
Teflon to teflon	0.10

(6) Wind Load: Basic wind speed of 70 mph in accordance with ANSI A58.1-1982, exposure C, importance factor = 1.07.

(7) Seismic Load: Seismic Zone 1 in accordance with TM 5-809-10, importance factor = 1.0, "W" includes 70% snow load.

(8) Load Combinations: Load combinations are in accordance with TM 5-809-1.

2. Materials. Materials to be used are summarized as follows:

(1) Structural Steel: ASTM A36; design is in accordance with AISC Steel Construction Manual and TM 5-809-6.

(2) Grating: Steel grating with l-in. x 3/16-in. bearing bars.

(3) Concrete: 4,000 psi at 28 days, Type I cement. Design is in accordance with ACI 318, Building Code Requirements, and TM 5-809-2.

(4) Reinforcement: Deformed bars conforming to ASTM A615; welded wire fabric conforming to ASTM A185.

3. Foundations. The foundations are designed as spread/mat footings in accordance with Final Foundation Recommendations CEHND-ED-CS dated January 29, 1988. The design parameters are as follows:

Net bearing capacity = 1,500 lb/ft^2 with one-third increase for wind or seismic loads
Minimum footing width = 24 in.
Minimum frost depth = 30 in.
Long-term settlement = 1 in. or less with a differential settlement of 1/2 in. or less

Modulus of subgrade reaction = 120 pci. Lateral earth pressure:

Material	At Rest	Active	Passive
Granular	0.5	0.33	3.0
Clay silt	0.9	0.8	1.5

Slab-on-grade is designed in accordance with TM 5-809-2 with live loads less than 400 lb/ft^2 or 5,000 lb concentrated load.

B. Functional and Technical Requirements

1. Duct and Pipe Supports. Duct supports are designed as rigid/braced steel frames. Pipe/duct supports are designed as free standing steel T-supports. Pipe supports also carry electrical conduits. Steel is used for the supports because of its economy and flexibility in design and construction.

2. Foundations. All foundations are minimum 6 in. above grade and 2 ft 6 in. below grade. The glycol and fuel oil storage tanks are enclosed by a concrete dike wall to contain the spillage. The concrete floor within the diked area slopes to a secondary collection sump. The pumps handling fuel oil and glycol cooling medium are enclosed by a concrete curb and the concrete floor within the curbed area slopes to a secondary collection sump. All the equipment is tied down to the foundation by anchor bolts.

3. Stack. The stack is a carbon steel, free-standing stack. It is designed to withstand wind and seismic forces and is also analyzed for the effects of vortex shedding. However, this design is for information only. The LIC package

supplier will design and supply the stack in accordance with applicable specifications for the actual conditions.

2.9.3 MECHANICAL PROCESS

A. General Parameters

1. Scope and Purpose. The mechanical process functions provide a detailed development of the utility supply and distribution systems with definitions given of sizes, capacities, design pressures, and materials of construction for all equipment and piping required. P&IDs describe the functional relationship of the equipment with the various monitoring and control devices required for systems operation.

2. Utility Systems. The utility systems consist of equipment and piping for fuel oil, LPG, instrument/plant air, life support, life support bottle filling, simulated decon, cooling medium, glycol (simulated agent), and process water.

3. Types of Equipment. Equipment consists of tanks, pumps, compressors, heat exchangers, filters, valves, controls, agitators, and all interconnecting piping.

4. Design Guidance. Unless stated otherwise, all systems are in accordance with criteria and design requirements provided in the report, Central Training Facility, Project Development Brochure, APG, September 1987.

B. Functional and Technical Requirements

1. Fuel Oil System. The fuel oil system consists of a truck-unloading station, an unloading pump, a storage tank, a transfer pump with spare, a day tank, and distribution piping. The main fuel oil storage tank is an atmospheric tank designed in accordance with National Fire Protection Association (NFPA) requirements. Distribution piping extends to the fuel oil day tank: the day tank for the hot water boilers is located in the boiler room. The 8,000-gal-capacity storage tank is sized for a 30-day building heating demand.

The fuel oil day tank has a 120-gal capacity. This size is based on regulations for hazardous materials and liquids from the Uniform Building Code. The controls of the day tank monitor the tank level from 60% to 90% of capacity during normal operation. The unloading pump is a centrifugal type with a rated capacity of 110 gal/min. The transfer pumps are gear type, rated at 10 gal/min capacity.

2. LPG System. The LPG system consists of an LPG storage tank with a capacity of 1,600 gal, a vaporizer, truck-unloading station, unloading pump, and distribution lines. The LPG storage tank capacity is a 2-week supply. A 2-week supply is provided to allow an adequate reserve to overcome an interruption in delivery due to inclement weather, transportation problems, etc. The LPG storage tank is designed in accordance with NFPA 58 and 59. Distribution piping is also designed in accordance with applicable NFPA requirements.

The LPG vaporizer package unit has a duty of 10 kW, based on a maximum startup heating load of 4,000,000 Btu/hr for the LIC furnace. The LPG is distributed to the furnace and domestic hot water heaters. The unloading pump is a vertical centrifugal type with a rated capacity of 50 gal/min.

3. Instrument/Plant Air System. The instrument/plant air system consists of a 100% reciprocating oil-free canpressor package, two air dryers (one operating and one standby) with prefilters, afterfilters, and an instrument/plant air receiver. The compressor is rated for a capacity of 235 scfm at 125 psi. Instrument/plant air is supplied to the following users:

(1) Atomizing air for the LIC furnace
(2) Agent transfer pumps
(3) Slide gates
(4) Munitions-handling machines
(5) Utility stations
(6) Instruments
(7) HVAC systems

The instrument/plant air is compressed to 125 psig, dried to a -40°F dewpoint, and supplied to instrument/plant air users through a piping distribution network. The instrument/plant air dryers are the heatless, desiccant type, rated for the full flow and pressure and are designed in accordance with ASME Section VIII. The air dryer regeneration timer is interlocked with the air-compressor motor so that the regeneration sequence proceeds only when the air compressor is operating. The air receiver is sized to provide air to all users in order to perform an orderly shutdown. The air receiver provides air for 5 minutes with pressure decreasing from 125 to 90 psig.

The receiver is designed in accordance with ASME Section VIII and is protected with a relief valve set at 140 psig. The air compressor is controlled by step-control regulating suction valve unloaders for loading and unloading. A dual control is provided that shuts down the compressor when air demand is low and restarts it when air demand increases. A hand selector switch allows the operator to select either step control or automatic start/stop. A timer is provided to prevent the motor from being cycled excessively. If there is no increase in demand, the compressor automatically shuts down and is ready to start on demand. The compressor remains off until the pressure in the receiver drops below 100 psig. The receiver pressure is normally maintained at 125 psig.

4. LSS. LSS provides primary breathing and cooling air to the DPE wearer. The LSS air supply consists of a 100% nonlubricated air-compressor package, an air purification and dryer package, air receiver, and air distribution network that delivers air both to hose stations for DPE entry into Category A areas and to the LSS bottle-filling system. The LSS air supply equipment is located in the MER. The compressor is rated for a capacity of 225 scfm at 125 psi.

During DPE activity, the LSS may be operated in either the manual or automatic mode. In the manual mode, the compressor operates continuously. In the automatic mode, the compressor remains off when the LSS header pressure is above 100 psig. The receiver is sized to support 18 DPE wearers with breathing and cooling air for approximately 5 minutes of evacuation time in case of emergency. During this period, the receiver provides air as the pressure decreases from 125 to 90 psig.

5. LSS Bottle-Filling System. The LSS bottle-filling system consists of a lubricated air-compressor package with an air purification unit that provides high-pressure air to charge life-support air bottles that are located in storage racks at critical locations within the MDB. The canpressor is rated for a capacity of 5 scfm at 3,000 psi. The air pressure is 2,475 psig for air-bottle refilling. System operation is by manual control only. A relief valve set at 2,600 psig is provided to protect the filling system from being overpressured by the compressor.

6. Simulated Decontamination Solution System. This system will make, store, and distribute simulated decontamination solution. The simulated decon solution is diluted to 1% by weight in the simulated decon mix tank by mixing water and Nalcolyte (TM) 7744, an anionic flocculent, with the decon tank agitator. This solution is further diluted to an effective concentration of 200 to 500 ppm by in-line mixing with water. The solution will simulate the slippery effects of caustic soda without the waste problems associated with caustic soda.

Simulated decontamination solution is used for the Category A airlock decontamination showers, DER, and TMA. Solution is supplied to the distribution header by the simulated decon injection pump.

7. Cooling Medium System. The cooling medium system provides direct cooling for the instrument/plant air compressors, LSS air compressor, and the hydraulic power unit cooler. A 50% solution of glycol in water is used as the cooling medium. The supply header temperature is set for a maximum of 110°F, based on 95°F summer ambient temperature.

The cooling medium system consists of a 50-gal expansion tank, a fin-fan cooler (duty of 500,000 Btu/hr), two circulation pumps (one operating and one spare), and supply/return piping. The circulation pumps are centrifugal type with a rated capacity of 77 gal/min each.

8. Glycol System. Ethylene glycol is used as the simulated agent. The system consists of a truck-unloading station, unloading pump, storage tank, transfer pump, return pump, and distribution piping. The glycol storage tank has a 3,500-gal capacity. The tank provides sufficient capacity for a normal truck delivery system (capacity 1-1/2 times delivery). It allows for the storage and transfer of simulated agent, and it allows munitions to be processed without the LIC furnace operating by receiving simulated agent from the agent holding tank. The unloading pump is a centrifugal type with a rated capacity of 110 gal/min. The glycol transfer pump is a magnetically coupled seal-less gear pump sized for 11 gal/min. The seal-less design prevents simulated agent leakage and requires low maintenance. This pump supplies glycol for filling the agent holding tank and to the munitions-filling station for filling munitions for reuse.

The glycol return pump is an air-operated diaphragm pump sized for 22 gal/min. This pump returns glycol to the storage tank if the LIC furnace is not operating and a high-high level is reached in the simulated agent holding tank.

9. Process Water System. The process vater system consists of distribution piping that branches off the main water supply header. Process water is distributed to the following users: utility stations, decon showers, hot water boilers, LIC exhaust gas cooler, simulated decon mix tank and in-line dilution, rocket shear machine, and the projectile/mortar disassembly machine.